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(54) **METHOD FOR PLAYING A VIDEO GAMING MACHINE**

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(58) Field of Search ..... **463/13, 20, 25; 273/292, 138.1, 138.2**

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(57) **ABSTRACT**

A method for playing video gambling games whereby pay tables vary from play to play, or, alternatively, whereby a plurality of pay tables are possible within a game. For example, in a video poker game a player wagers against a first pay table. If a winner occurs, the next game offers a new pay table with a greater expected value. This process continues until the player loses, whereupon the player is returned to play against the first pay table. Pay tables increment and decrement in expected value based on achieving predetermined events within the current game, within a previous game or games or randomly.

**20 Claims, 5 Drawing Sheets**

PAYTABLE	Successive Games									
	Game 1	Game 2	Game 3	Game 4	Game 5	Game 6	Game 7	Game 8	Game 9	Game 10
Final Hand	Pays	Pays	Pays	Pays	Pays	Pays	Pays	Pays	Pays	Pays
Royal Flush	600	650	700	750	800	850	900	950	1000	2500
Straight Flush	50	55	60	65	70	75	80	85	90	500
Four of a Kind	20	25	30	35	40	45	50	55	60	100
Full House	7	8	9	10	11	12	13	14	15	50
Flush	5	6	7	8	9	10	11	12	13	60
Straight	4	5	6	7	8	9	10	11	12	25
Three of a Kind	3	4	5	6	7	8	9	10	11	20
Two Pair	2	3	4	5	6	7	8	9	10	15
Pair of Jacks or Better	1	1	1	1	1	1	1	1	1	10
Pair of Tens or Less	0	0	0	0	0	0	0	0	0	5

PAYTABLE	<i>Successive Games</i>				
	Game 1	Game 2	Game 3	Game 4	Game 5
Final Hand	Pays	Pays	Pays	Pays	Pays
Royal Flush	600	650	700	750	600
Straight Flush	50	55	60	65	50
Four of a Kind	20	25	30	35	20
Full House	7	8	9	10	7
Flush	5	6	7	8	5
Straight	4	5	6	7	4
Three of a Kind	3	4	5	6	3
Two Pair	2	3	4	5	2
Pair of Jacks or Better	1	1	1	1	1
Pair of Tens or Less	0	0	0	0	0

FIG. 1

PAYTABLE	Successive Games									
	Game 1	Game 2	Game 3	Game 4	Game 5	Game 6	Game 7	Game 8	Game 9	Game 10
	Pays	Pays	Pays	Pays	Pays	Pays	Pays	Pays	Pays	Pays
Final Hand										
Royal Flush	600	650	700	750	800	850	900	950	1000	2500
Straight Flush	50	55	60	65	70	75	80	85	90	500
Four of a Kind	20	25	30	35	40	45	50	55	60	100
Full House	7	8	9	10	11	12	13	14	15	50
Flush	5	6	7	8	9	10	11	12	13	50
Straight	4	5	6	7	8	9	10	11	12	25
Three of a Kind	3	4	5	6	7	8	9	10	11	20
Two Pair	2	3	4	5	6	7	8	9	10	15
Pair of Jacks or Better	1	1	1	1	1	1	1	1	1	10
Pair of Tens or Less	0	0	0	0	0	0	0	0	0	5

FIG. 2

PAYTABLE	<i>Successive Games</i>				
	Game 1 Pays	Game 2 Pays	Game 3 Pays	Game 4 Pays	Game 5 Pays
Final Hand					
Royal Flush	600	500	2500	500	800
Straight Flush	50	50	500	500	50
Four of a Kind	20	50	25	1000	20
Full House	7	50	10	9	7
Flush	5	10	8	8	5
Straight	4	8	6	25	4
Three of a Kind	3	6	4	6	3
Two Pair	2	4	2	5	2
Pair of Jacks or Better	1	2	2	1	1
Pair of Tens or Less	0	0	2	0	0

FIG. 3

PAYTABLE	Successive Games				
	Game 1	Game 2	Game 3	Game 4	Game 5
Final Hand	Pays	Pays	Pays	Pays	Pays
Royal Flush	600	500	2500	500	800
Straight Flush	50	50	500	500	50
Four 2s, 3s or 4s	100	100	25	1000	20
Four 5s through Aces	50	75	100	500	20
Full House	7	50	10	9	7
Flush	5	10	8	8	5
Straight	4	8	6	25	4
Three of a Kind	3	6	4	6	3
Two Pair	2	4	2	5	2
Pair of Eights or Better	1	2	2	1	1
Pair of Sevens or Less	0	0	2	0	0

FIG. 4

PAYTABLE	Successive Games									
	Game 1	Game 2	Game 3	Game 4	Game 5	Game 6	Game 7	Game 8	Game 9	Game 10
	Pays	Pays	Pays	Pays	Pays	Pays	Pays	Pays	Pays	Pays
Final Hand										
Royal Flush	600	650	700	700	700	650	650	800	650	650
Straight Flush	50	55	60	60	60	55	55	50	55	55
Four of a Kind	20	25	30	30	30	25	25	20	25	25
Full House	7	8	9	9	9	8	8	7	8	8
Flush	5	6	7	7	7	6	6	5	6	6
Straight	4	5	6	6	6	5	5	4	5	5
Three of a Kind	3	4	5	5	5	4	4	3	4	4
Two Pair	2	3	4	4	4	3	3	2	3	3
Pair of Jacks or Better	1	1	1	1	1	1	1	1	1	1
Pair of Tens or Less	0	0	0	0	0	0	0	0	0	0

FIG. 5

## METHOD FOR PLAYING A VIDEO GAMING MACHINE

This application claims the benefit of Prov. application No. 60/218,299 filed Jul. 14, 2000.

### BACKGROUND—FIELD OF INVENTION

The invention relates to gaming machines generally, and in particular to methods of play and pays for a video gambling machine.

### BACKGROUND—DISCUSSION OF PRIOR ART

One of the most common gambling devices in use today is the slot machine. Originally, slot machines were mechanical and had 3 or 4 independent reels side-by-side. Each reel had several symbols painted on it. Inserting a coin and pulling a large spring-loaded handle set the reels spinning independently, and when the same symbols landed in a row across the reels, a winner occurred and coins were released from the machine.

Today, many new slot machines are in video form. Video slots are becoming more and more popular with players. The video platform offers more flexibility in game development and results in more complicated and more involving and entertaining games. These new video slots are controlled by an internal computer. They usually don't have a large handle anymore, and some don't even have buttons, using touch-screen panels to make player choices instead.

The video slot machine usually consists of a cabinet built mostly of metal and plastic that houses many different internal components. The basic functions are coin acceptance, game play and coin dispensing, although it is becoming increasingly common for slot machines to accept and pay back in currency or coupons instead of, or in addition to coins.

Coin acceptance is most often done by means of a coin head where coins are inserted into the game. A coin chute directs the coin into an internal coin hopper, if equipped, or into a removable drop bucket beneath the machine when the hopper is full. Winners may be paid back to players from the coin hopper through a small chute where coins land in a special tray where they are available to the player. Again, bill acceptors common today may accept and payout in currency or coupons in addition to or instead of coins.

Internally, game play is managed by a central processor on a printed circuit board similar to that of a standard personal computer. CD-ROMs and proms (programmable read-only memory computer chips) are often used, too. A power supply provides the current, and the game is displayed back to the player on a video monitor. Buttons on the outside of the cabinet provide for player input, although sometimes touchscreen panels are affixed to the monitor and used in addition to, or instead of buttons. Other printed circuit boards perform auxiliary functions, and there are usually mechanical meters counting coins in and out. Too, there is internal lighting to make the game clearly noticeable, and external glass usually shows the rules of the game. Finally, games may be networked to each other to report game and player statistics to the accounting office, or to play special games that are somehow linked to each other in a variety of different configurations.

A traditional non-video slot machine equipped with mechanical reels is largely the same as a video slot, except that the video display is replaced with a mechanical spinning reel assembly. Some games in use today are hybrids and use both mechanical reels and a video display.

Newer video slots usually show 5 reels side-by-side that spin on a common axis instead of the traditional 3 or 4 mechanical reels. These newer video slots usually display 3 symbols on each of the 5 reels, for a total of display of 15 symbols. This creates a video display matrix of 3 rows by 5 columns. Sometimes the number of reels and symbols displayed differ. Some new video slots display 4 symbols on 4 reels, for a total of 16 symbols. Others have independent reels showing just 1 position of each reel.

Displaying more symbols allows more wagering opportunities. Instead of a single paying row across the reels, there are often many different pay lines that can be wagered on. Usually, these pay lines run in different paths through each of 5 reels displayed. Players select which pay lines to wager on, they wager 1 or more credits per pay line and they may win on more than 1 pay line after a single spin of the reels.

Another popular feature of video slot machines is the use of bonus screens. Certain symbols trigger a bonus game that is often called a "second screen" game. The second screen game is usually separate and distinct from the normal video reel display, and a player might select a car in a car race or scratch from a selection of video lottery tickets in an attempt to win credits, free games or anything of value. Some games even offer third screens or more, enhancing player interest and intrigue. After the bonus game, the player is usually returned to the normal video reel display and winnings, if any, are posted to the player's onscreen credit meter for subsequent play or cashout.

Another popular form of video slot machine is the video poker machine. Instead of a video representation of a slot machine, video poker cards are dealt randomly and displayed onscreen. Usually 5 cards are dealt from a video representation of a common playing card deck of 52 cards and the player, using physical buttons, touchscreen or similar device, selects which cards to hold and which cards to discard, if any. A player may discard from 0 to all 5 cards. Then, the player draws from 0 to 5 new cards from the 47 cards remaining in the original deck, replacing any discards in an attempt to better the hand. This hand is compared to a predefined pay table which determines the amount of the win if a win or a loss. This game is commonly known as draw poker.

The pay table was developed as a way to pay players when there are no opponents. These games are sometimes called "house banked" games, since the house (casino or gambling operator) pays players for winning. Alternatively, they are sometimes called "player's hand only" games, since it is usually only the player's hand that is relevant. Winnings do not come directly from other losing players, as in normal card games. The pay table is a fixed, predefined schedule of pays for hands designated as winners.

A typical pay table for video draw poker machines looks like this. (Pays shown are returns for 1 coin wagered):

TABLE 1

Common Video Poker Pay Table

Hand	Pay
Royal Flush	800
Straight Flush	50
Four of a Kind	25
Full House	9
Flush	6
Straight	4
Three of a Kind	3

TABLE 1-continued

Common Video Poker Pay Table	
Hand	Pay
Two Pairs	2
Pair of Jacks (or Better)	1
Pair of Tens or Less	0

The hand is compared to the pay table to see if a win occurs, and if so, how much it pays. The pay amount is then multiplied times the number of coins or credits wagered, usually from 1 to 5, to determine the amount of the win, if any. If 5 coins are bet, for example, and a royal flush is obtained, then 4000 coins are paid to the player ( $5 \times 800 = 4000$ ). Note that one credit is equal to one coin, and that these terms are used interchangeably herein.

The pay table defines the game objectives for the player in terms of a monetary reward or payback. The payback for each hand can be multiplied by its expected frequency of occurrence to derive an overall game payback percentage for the player. Since strategy is an integral part of the game, that is deciding which cards to hold and which to discard, an optimal strategy is usually used to determine an optimal game payback. An optimal strategy employs the best draw decisions for every possible hand dealt. Since perfect play is rare, an expected payback is usually also found that accounts for sub-optimal play due to human error or incorrect decision making.

In the example shown in Table 1, the expected payback would be found by multiplying a winning hand pay by the % frequency to arrive at an expected value. The expected values of each pay are then summed to arrive at an overall expected value, or optimal payback, for the game overall.

TABLE 2

Finding the Optimal and Expected Payback			
Hand	Pay	% Frequency	Expected Value %
Royal Flush	800	0.0028	2.8000
Straight Flush	50	0.0111	0.5550
Four of a Kind	25	0.2355	5.8875
Full House	9	1.1484	10.3356
Flush	6	1.1129	6.6774
Straight	4	1.1306	4.5224
Three of a Kind	3	7.4148	22.2444
Two Pairs	2	12.8898	25.7796
Pair Jacks (or Better)	1	21.2649	21.2649
Pair of Tens or Less	0	54.7892	0.0000
Total		100.0000%	100.0668%

Note:  
Optimal payback is 100.0668% with perfect play. Expected payback is 2.0% less due to sub optimal play, or 98.0668%.

It is important to point out the fixed nature of the pay table. Some games will accept bets of up to 100 coins or more, but the amount of the win is simply multiplied by the number of coins bet to determine the total pay. In our example above, but with a bet of 100 coins, the pay would be 8000 ( $100 \times 800 = 8000$ ).

Note that the pay table in Table 2 is somewhat atypical, since the optimal expected value exceeds 100.0%. Gambling operators usually rely on sub optimal play by players to assure they retain their mathematical advantage. At other times such a pay table is used for marketing so that operators can advertise greater than 100% paybacks, or as a skill game to generate activity in certain areas.

Since the pay table defines a player's objectives and rewards, some poker variants have been devised to better the pay table returns in an attempt to be more appealing to the player.

Some poker variations change only the pay table and are known by such names as bonus poker or double bonus poker. They still play by the same rules of draw poker and pay according to a single, fixed pay table. The common thread in these games is that the pays for individual hands vary from the normal ranking. Four deuces might offer a better pay than 4 kings, for example. The drawback of these games is that what is normally a greater hand pays less than what is normally a lesser hand. Another drawback is that any single, fixed pay table game can become boring after awhile.

Many offer a bonus for playing more coins. On the royal flush hand it is common to pay 250 for 1 if wagering from 1 to 4 coins, but 800 for 1 if betting the maximum 5 coins. One drawback of this game is that in order to accommodate the bonused hand pay, the pay table returns for the other winning hands are reduced. (This is required to retain a house advantage.)

Another variation of video poker includes a progressive jackpot pay. A progressive increases the pay for a given hand based on the amount that the game has been played until the progressive award is paid out, whereupon it is reset to its starting value. For example, many video poker machines have a progressive royal flush award. The pay for the royal flush might start out at the reset value of 800, but then increase at a typical rate of 1% of moneys wagered. Assuming that \$1000 has been wagered since reset, then 1% (\$10) is added to the pay for a royal flush so that 810 is the value on the pay table (shown on a mechanical meter or video display). Note this example assumes one credit or one coin is worth one dollar. (Poker games are offered in various denominations.) As soon as the royal flush is won and paid, its pay returns to its reset value, and it starts over, incrementing again based on the amount of money wagered.

Some video poker machines have multiple progressives. They may offer a progressive jackpot pay on 4-of-a-Kind and a Royal Flush hand, for example. It is also common to link several machines such that the total amount wagered on all machines contributes to the progressive pay. When it is won and paid on any machine on the link, the pay is restarted at the reset value on all linked machines. By linking multiple machines in this manner, the progressive usually increases much faster which builds player interest and excitement. One drawback of progressives, is that in the non-progressive portions of the pay table hand pays must be reduced to compensate for the additional percentage paybacks granted in the progressive hand wins to ensure the house advantage.

Double down stud, as described in U.S. Pat. No. 5,167,413, has no conventional draw. It does, however, permit a player to raise the bet in an attempt to receive a greater return. A drawback of this game is that it requires an additional wager to yield a greater return.

Triple play poker, as described in U.S. Pat. No. 5,823,873, allows held cards to be played as multiple hands and each drawn to independently, usually resulting in 3 different hands. Although each hand pays according to the single pay table, a drawback of this game is that to play each additional hand requires an additional wager.

The poker game described in U.S. Pat. No. 6,132,311 may include a bonus multiplier where obtaining a special symbol multiplies any winning payout by a fixed integer. This game also allows multiple hand play for a single wager. A drawback of this game is that the pay table must be reduced to

5

compensate for the bonus multipliers and multiple hand winners, again to ensure the house retains its advantage. Another drawback is that multiplying any winning payout by a fixed integer does not allow for more subtle variations in the pay table returns.

The gaming device described in U.S. Pat. No. 6,234,897 may include a poker hand as a bonus feature on a traditional slot machine. One drawback of this game is that the poker pay table offered thereby (and the related expected value) is a function solely of the triggering base game outcome. Therefore, once triggered it becomes, in effect, a single fixed pay table.

A drawback of all fixed pay table games is that to be played optimally, they require the same strategy be employed. That is, once you know the correct strategy for a certain pay table, you play that strategy over and over again and the game eventually becomes boring, monotonous and routine.

Other video card games include rummy, where the pay table pays for runs and sets, video blackjack, other poker variations such as 7-card stud, and community card games such as Texas hold'em, Omaha and pai gow poker, for example.

Gambling operators try to offer the most entertaining and exciting gambling games possible to stimulate greater play and increase profits. A common theme in new games is the attempt to offer a greater return for a given wager in a manner that appeals to players. Since the house must retain its advantage, however, game designers are limited in what they can do and many new games result in a simple tit-for-tat exchange of pays within the pay table. That is, one hand pays more while another hand pays less. Due to the repetitive nature of traditional game play, operators' desires to increase play and the proliferation and acceptance of gambling worldwide, the need for new and exciting video card games is greater than ever. The present invention is directed to satisfying these needs.

#### OBJECTS AND ADVANTAGES

Accordingly, several objects and advantages of this invention are:

1. This invention provides variety. Variety is important, because players tire of the same old games. New games and features are exciting and lead to increased play and greater profits for gambling operators.
2. This invention may be applied to virtually all existing video gambling card games, making them more interesting and extending their life cycle!
3. This invention makes games more fun to play.
4. This invention adds player interest and depth, making games with this invention more involving for players. Variable pay tables require different strategies for optimal results.
5. This invention can be applied to existing or new games in innumerable ways. This invention opens a whole new realm of possibilities for gambling device designers, developers and manufacturers. The number of pay tables can be extended infinitely. The number of paying hands within these pay tables can be adjusted up or down. The returns for any given hand can be infinitely adjusted. The triggering events themselves—that which causes a pay table to change, whether symbols, sequences of events, successive wins or losses, etc., can be virtually infinite.
6. This invention focuses on the manner in which players are paid. Obviously, this is very important to players.

6

This aspect of gambling games has been largely missed by game developers, who have only come up with limited ways to modify player returns, especially in video gambling card games.

7. The multiple pay tables offered under this invention permit very fine tuning of a game's expected value. Simple tit-for-tat changes in existing poker pay tables, for example, where a player accepts a lesser return for a hand in one area of the pay table in exchange for a greater return for another hand, are limiting and obvious to players. Using the variable, multiple pay tables of this invention offers virtually infinite adjustment of a game's expected value. Further, any tit-for-tat type changes in the pay tables of this invention can be made much less obvious and virtually opaque to players.
8. This invention can be used as an incentive-producing means for players. That is, it can be used in such a manner as to encourage additional play. The right to play against a heavily escalated pay table offering a greater expected value is something to be sought after!
9. In certain embodiments, this invention can be used as a reward for playing and not paying! Many existing games require greater bets for the possibility of greater returns. This invention can be applied without requiring additional or greater bets.
10. By employing this invention, the pay table and its expected value can be set to fluctuate considerably. Therefore, it is possible to offer exceptionally high expected values for a short time offset by lower expected values at other times so that the overall expected value remains within a range acceptable to gambling operators. Similarly, individual hand pays can be temporarily set far above industry norms, since they are only available for a limited time, which is exciting and appealing to players.

Further objects and advantages of my invention will become apparent from a consideration of the drawings and ensuing description.

#### SUMMARY

The present invention offers a set of varying pay tables yielding different expected values in video gambling card games such as electronic video poker, rummy and other games that employ pay tables based on player hand rankings. The present invention has many versions with the common thread being a plurality of pay tables (and their related expected values) occurring as a result of successive wins and losses within successive games, other events or randomly.

#### DRAWINGS

FIG. 1 is a typical screen display showing five sample pay tables that might occur given three consecutive winning hands followed by a losing hand employing the present invention.

FIG. 2 is a typical screen display showing ten sample pay tables that might occur randomly or based on other events employing the present invention.

FIG. 3 is a typical screen display showing five sample pay tables that might occur randomly or based on other events where individual pays may vary from hand to hand employing the present invention.

FIG. 4 is a typical screen display showing five sample pay tables that might occur randomly or based on other events where the hands themselves are variable using the present invention.

FIG. 5 is a typical screen display showing ten sample pay tables that might occur showing the use of incrementing and decrementing pay tables using the present invention.

#### DETAILED DESCRIPTION

##### Preferred Embodiments

A conventional electronic video poker or video slot machine is used to practice the method of the present invention. Said video poker or video slot machine (the "gambling device") usually has electronic computer controls, a coin or note hopper, coin-in handling equipment, currency-in handling equipment (such as a bill acceptor), a video display and other optional equipment such as player tracking apparatus as is conventional. The computer controls are programmed to display and operate the method of the present invention. The pay table is shown on the video display or affixed to the exterior of the gambling device so that it is convenient and conspicuously available to the player.

In the preferred embodiment, this invention is employed with a video poker game. A player wagers on a video draw poker machine. Each successive winning hand (a pay of 1 or more) causes the pay table to escalate as shown in FIG. 1, so that on the next game the player plays for a greater expected value. Upon a losing hand (a pay of 0), or reaching a preset limit in the number of greater pay tables offered, the pay table resets to its starting values. As shown in FIG. 1., if a player bets one coin and gets 4 successive hands of a Straight, Flush, Pair of Queens and Pair of Twos, the pay table escalates 3 times—once for each winner—before resetting to its starting pay table values due to the losing Pair of Twos hand. The Hand #5 pay table shown is a reset pay table, equivalent to the starting Hand #1 pay table. In this embodiment, each game, regardless of the current pay table offered, requires a new wager.

Note there is no requirement that all pays in the pay table must escalate. In the example shown in FIG. 1, losers continue to pay 0 and the Pair of Jacks (or Better) hand continues to pay just 1, while other pays escalate in varying amounts.

This embodiment rewards the player for winning, which is exciting in itself. It is also more involving for the player, since optimal player strategy is changed. Players are encouraged to keep winning and escalate the pay table for the next play.

In another preferred embodiment, the invention is employed in a second-screen poker game on a 5-reel video slot machine. After placing a wager, a player plays a video slot machine. Achieving predefined symbols within the active video display triggers a second-screen feature game. In said feature game, a player plays house-banked video draw poker by traditional rules, but employing the variable pay tables of this invention. Final poker hands are paid according to the current pay table, however, a winning hand allows the player to play draw poker again against a better pay table as shown in FIG. 2. All poker wins are retained and accumulated, and no additional bets are required to participate in successive poker games. When a player loses, however, or reaches a preset limit on the number of poker games allowed, wins, if any, are paid and the player is returned to the originating video slot game. In this embodiment, a maximum of 10 pay tables are possible upon 9 consecutive winning hands until the player plays the 10th and final game of video draw poker. This pay table is heavily escalated and after this 10th game wins are paid (or credited to the player's account), said feature game is over and the player is returned to the originating game to continue video slot play.

This embodiment adds a great deal of excitement to the game. Since no additional wager is required and wins are accumulated, this is very beneficial to the player.

In another preferred embodiment, the variable pay tables of this invention vary randomly from game to game irrespective of consecutive wins, losses or other events. Whether each hand requires a separate wager as in a dedicated video poker or other card game, or whether no wager is required for successive games but only consecutive winners as in a feature game within a video reel slot machine, the pay table varies from game to game as illustrated in FIG. 3. A further variation is shown in FIG. 4, whereby the paying hands themselves vary from game to game. Note that in FIG. 4, a Pair of Eights or Better is a winning hand and certain Four-of-a-Kind hands pay differently.

This embodiment stimulates players by encouraging a different strategy from game to game. This is more thought provoking. Too, players have a chance to earn exceptional returns on the right hands at the right time. Unlike the typical tit-for-tat fixed pay table differences of so many old poker variations, these variable pay tables are constantly changing and dynamic!

#### DESCRIPTION OF ALTERNATIVE EMBODIMENTS

In another embodiment, other events might cause the variable pay table to reset to its starting value or to a lesser expected value. In video poker, for example, any 4 of a Kind hand or any showing of the Queen of Spades might cause the pay table to reset or decline incrementally as demonstrated in FIG. 5.

In another embodiment, on a video slot machine a reel symbol designated as the Bump symbol might escalate the poker feature pay table one increment even before the poker feature game is triggered. Subsequent Bump symbols would boost it again, even if not occurring in consecutive games, and this could be repeated thereby escalating the pay table. This could continue until a subsequent event or symbol designated as the Reset symbol caused the pay table to return to its starting value. If poker feature was triggered while the poker feature pay table was heavily escalated, this would add great excitement and the possibility of winnings!

In yet another embodiment, there is no additional wager required to play a successive game. Escalated or variable pay table play may be offered as a reward for any previous event or randomly and may be offered as a free play game.

The variable pay table is a new invention that, in most embodiments, entices players to reach new thresholds that are rewarded with a greater expected value and potentially higher winnings in the next game. This adds fun and excitement. The method of obtaining a pay table fluctuation may vary. They may be random, or they may include any number of prior winners, non-winners or other events. In any case, these variable pay tables may replace any fixed pay table, which makes this invention applicable to a great many existing games.

Pay table variation is not merely a linear function of the same pay table award multiplied by the bet as in a typical 1 to 5 coin video poker game, nor does it bear any mathematical relationship to total moneys wagered as in a progressive jackpot. Pay table variation is rarely, if ever, attributable to the amount of the bet, although a minimum or additional wager may or may not be a requirement for pay table variation to occur.

This invention does not require that a pay table does in fact vary from that first offered, if, for example, the trigger-

ing event(s) have not occurred. Note too there is no requirement that pay table variations occur on successive games. It may be possible to increment the pay table, play at that escalated level for several games, then increment or decrement the pay table further based on some symbol(s), card(s), event(s) or sequence of events as shown in FIG. 5. Please note that in FIG. 1, FIG. 2, FIG. 3, FIG. 4 and FIG. 5, the pays shown are returns for a 1-credit wager and that greater wagers would be multiplied proportionately to determine actual win amounts.

While the invention has been illustrated with respect to several specific embodiments thereof, these embodiments should be considered as illustrative rather than limiting. Various modifications and additions may be made and will be apparent to those skilled in the art. The variable pay table invention may be offered in any game that uses any form of pay table, or in any such game routine called as part of another game such as a slot machine. The embodiments shown above may be combined to yield even more fascinating games. The pay table awards and/or increments may be fractional. A variable pay table does not have to be limited to a set number of pay tables at all, but may continue indefinitely. Conversely, there may be a limit to the amount of possible pay table variations and escalations.

#### CONCLUSION, RAMIFICATIONS AND SCOPE OF INVENTION

Accordingly, the reader will see that the variable pay tables of this invention are versatile and can be used as a powerful enhancement to most any video gambling game. The variable pay table adds a great deal of excitement to game play by at times increasing relative returns. The right to play for increasing expected values may be earned by players as a reward for a winning streak, or, alternatively, provided to a player after a bad losing streak! These rewards may be offered without the requirement of a greater or additional bet, so they are beneficial to the player. Escalating pay tables, for example, reward players for playing, not paying!

Too, this invention offers more flexibility in game design and development, since it provides a means for infinitely adjustable expected values. With this invention game expected values can now be fine tuned to a high degree of precision without materially altering the basic rules of underlying game play.

Furthermore, this invention offers random fluctuations in expected value that require changing player strategy to achieve optimum results. This leads to a more engaging and entertaining game and thereby longer playtime, which is a major objective of gambling device operators.

What is claimed is:

1. A method for playing a video gambling game with variable pay features, comprising the steps of:

providing a video gambling game comprising visual display means, payment means, legal tender receiving means and central processing means interconnected to a power source;

inserting legal tender into said legal tender receiving means to activate said video gambling game;

playing a first portion of said video gambling game having a first payable;

activating subsequent portions and pay tables of said video gambling game by achieving predetermined events in any preceding portion of said video gambling game wherein said subsequent pay tables include factors to be multiplied by the initial wager; and

receiving a payment from said payment means if a given result is achieved on said video gambling game.

2. The method of claim 1, wherein said subsequent pay tables increase or decrease in expected value in varying predetermined amounts.

3. The method of claim 1, wherein said subsequent pay tables increase or decrease in expected value randomly within a predetermined plurality of possible pay tables.

4. The method of claim 1, wherein said first pay table is selected randomly from a predetermined plurality of possible pay tables.

5. The method of claim 1, wherein said subsequent pay tables number at least three.

6. The method of claim 1, wherein said first and said subsequent pay tables comprise a means of pay table escalation.

7. The method of claim 1, wherein said video gambling game is a video gambling card game.

8. The method of claim 1, wherein said central processing means comprises a personal computer.

9. A method for playing a video gambling game with variable pay features, comprising the steps of:

providing a video gambling game comprising visual display means, payment means, legal tender receiving means and central processing means interconnected to a power source;

inserting legal tender into said legal tender receiving means to activate said video gambling game;

playing a first portion of said video gambling game having a first pay table selected from a plurality of possible pay tables;

activating subsequent pay tables of said video gambling game by achieving predetermined events in said first portion of video gambling game; and

receiving a payment from said payment means if a given result is achieved on said video gambling game.

10. The method of claim 9, wherein said subsequent pay tables increase or decrease in expected value in varying predetermined amounts.

11. The method of claim 9, wherein said subsequent pay tables increase or decrease in expected value randomly within a predetermined plurality of possible pay tables.

12. The method of claim 9, wherein said first pay table is selected randomly from a predetermined plurality of possible pay tables.

13. The method of claim 9, wherein said first pay table is selected by achieving a predetermined event in a game previous to the current game;

14. The method of claim 9, wherein said first pay table is selected by achieving a predetermined event in a plurality of games previous to the current game.

15. The method of claim 9, wherein said subsequent pay tables number at least three.

16. The method of claim 9, wherein said first and said subsequent pay tables comprise a means of pay table escalation.

17. The method of claim 9, wherein said video gambling game is a video gambling card game.

18. The method of claim 9, wherein said central processing means comprises a personal computer.

## 11

19. The method of claim 9, wherein said first portion of video gambling game is comprised of any game portion prior to the current portion.

20. A method for playing a video gambling game with a variable pay table, comprising the steps of:

initiating startup of said video gambling game upon receiving a signal acknowledging receipt of a payment means;

running said video gambling game in a first operating mode and providing a visual display of a reward achieved if a first required criteria is accomplished which not include the additional receipt of said payments means;

## 12

increasing said reward if a subsequent second required criteria is accomplished which does not include the additional receipt of said payments means; and

returning said video gambling game to said first operating mode if said first or said second required criteria is not accomplished,

whereby a plurality of pay tables are possible for any given video gambling game providing more flexibility in development, stimulating player interest, enhancing strategy and increasing the overall entertainment value.

\* \* \* \* \*



US006296568B1

(12) **United States Patent**  
**Tracy**

(10) Patent No.: **US 6,296,568 B1**  
(45) Date of Patent: **Oct. 2, 2001**

(54) **PYRAMID-STYLE VIDEO GAME METHOD AND DEVICE**

(76) Inventor: **Mark E. Tracy, 5225 E. Charlston, #2106, Las Vegas, NV (US) 89122**

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/410,590**

(22) Filed: **Oct. 1, 1999**

**Related U.S. Application Data**

(60) Provisional application No. 60/102,622, filed on Oct. 1, 1998.

(51) Int. Cl.<sup>7</sup> ..... **A63F 13/00**

(52) U.S. Cl. .... **463/17; 463/16; 273/237; 273/242; 273/243; 273/121 B**

(58) Field of Search ..... **273/121 B, 118 R, 273/119 A, 121 A, 236-238, 124 R, 124 A, 123 A, 118 A, 108.1, 138.1-139, 138.2, 463, 16, 17, 18, 31, 242, 243; 463/16, 17**

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*Primary Examiner*—Jessica J. Harrison

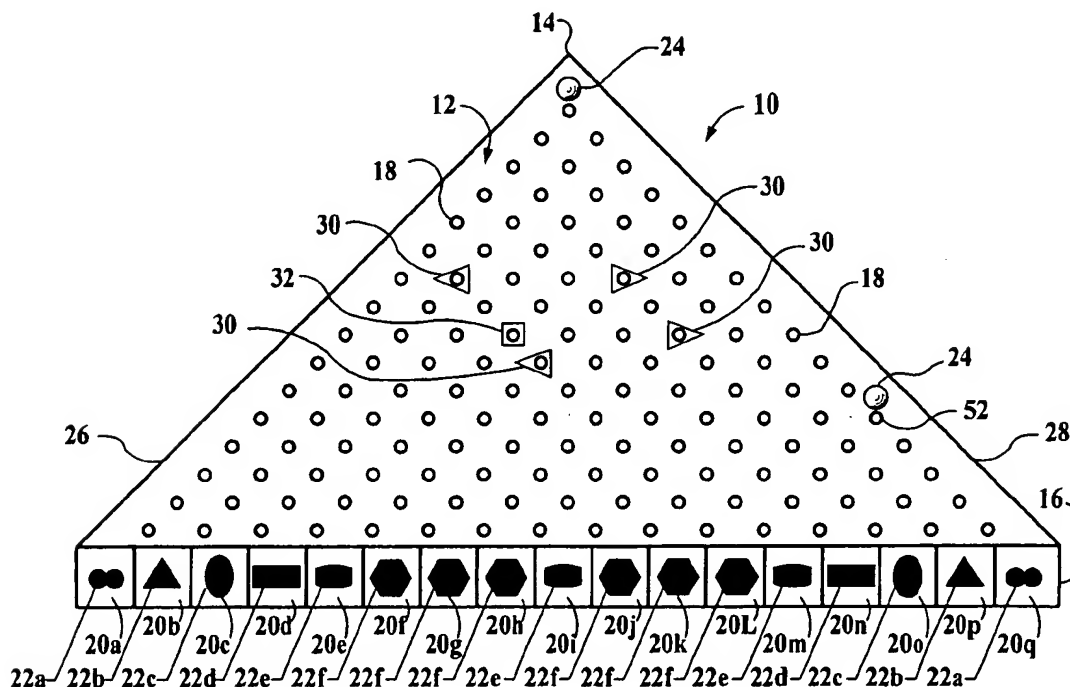
*Assistant Examiner*—Yveste G. Cherubin

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(57) **ABSTRACT**

A video game complete with player wagering includes a processor and a display controlled by the processor. Said display is a game board in the form of a pyramid having an apex, a base and a plurality of pins displayed on the game board. Also displayed at the base is a plurality of locations each defining an outcome for the game. During play, a character is displayed falling from the apex to the base being directed by contact with the pins. The game payout is dependent upon the base location ultimately occupied by the character. In a preferred embodiment the pins can be programmed as stop pins, lateral shift pins or bonus pins. Upon contact with the character the stop pin will end the game with no payout, the lateral shift pin will move the character to the left or right and the bonus pin will cause a bonus payout.

**13 Claims, 4 Drawing Sheets**



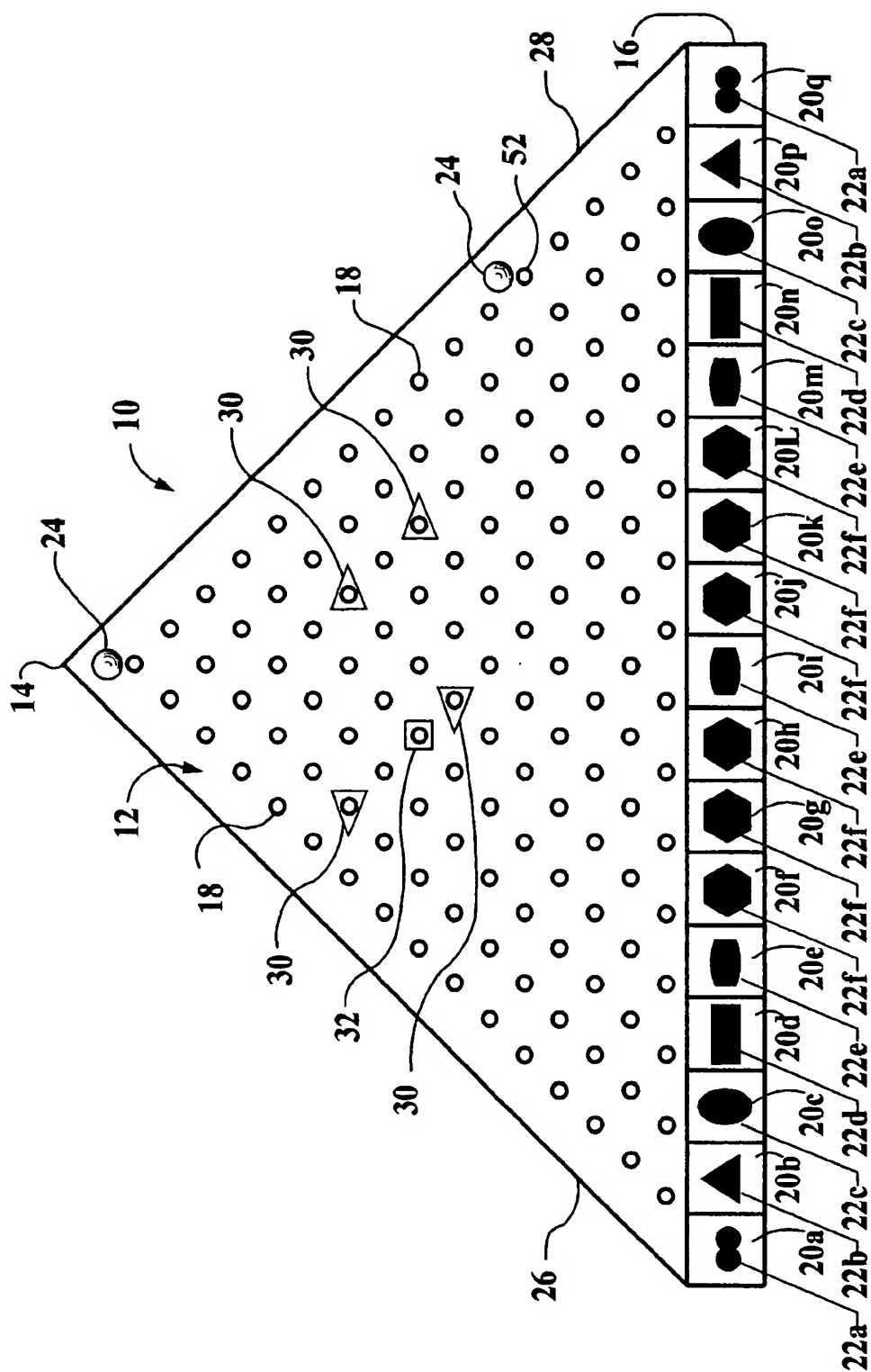
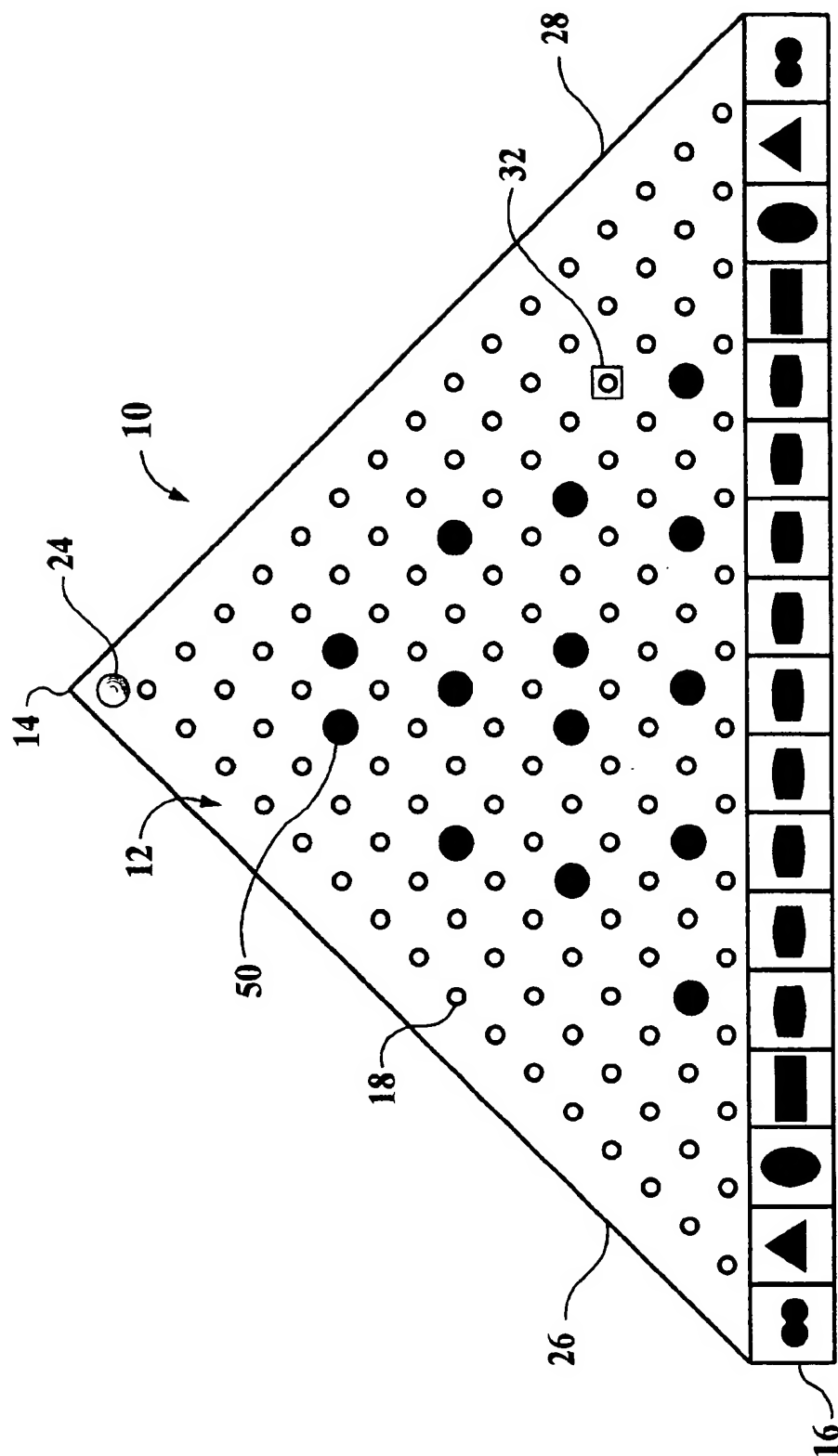








Fig. 1



**Fig. 2**

	BET 1 UNIT	BET 2 UNITS	BET 3 UNITS	BET 4 UNITS	BET 5 UNITS
	0	0	0	0	0
	1	2	3	4	5
	2	4	6	8	10
	5	10	15	20	25
	20	40	60	80	100
	200	400	600	800	1000

*Fig. 3*

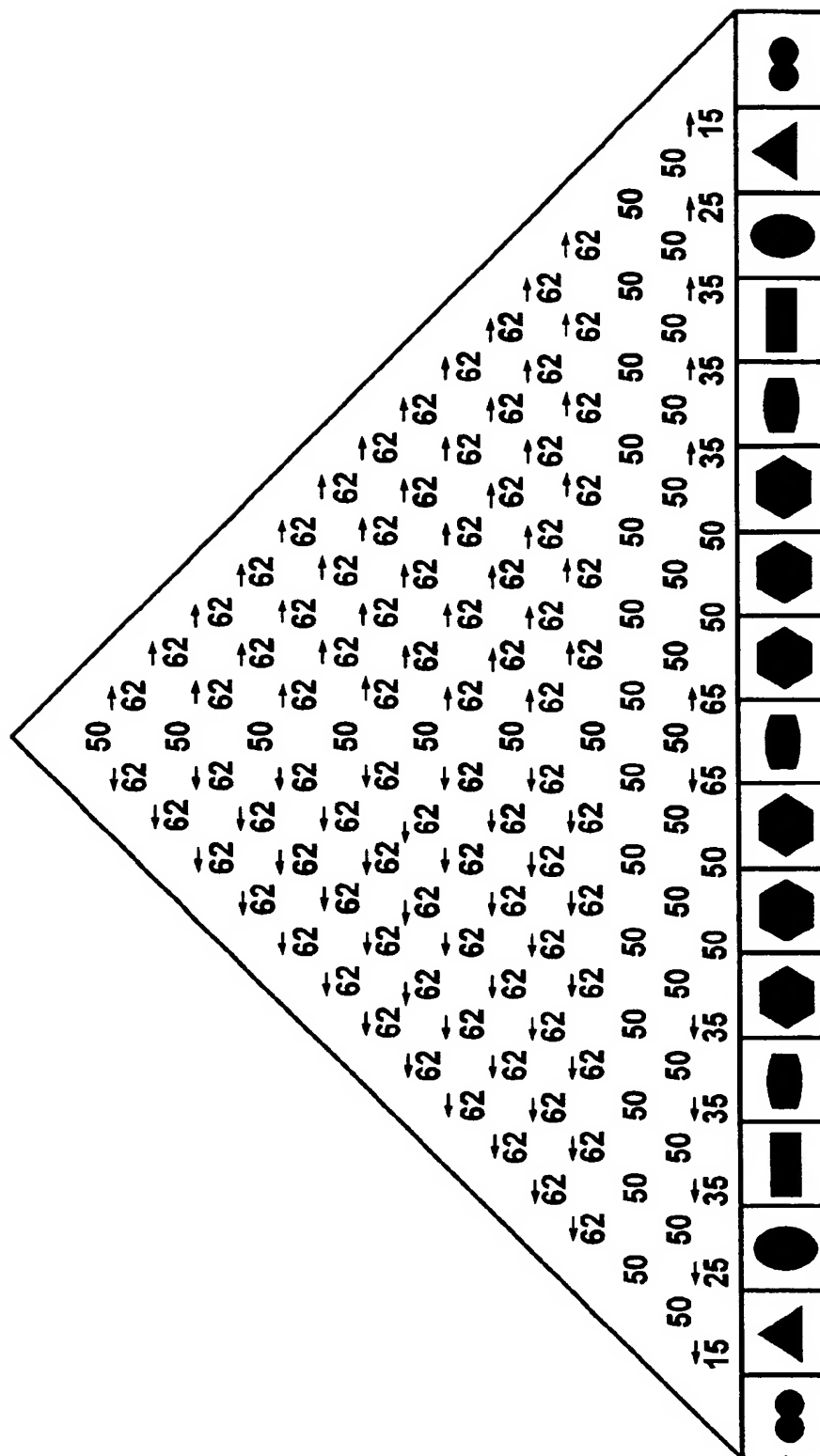


Fig. 4

1

## PYRAMID-STYLE VIDEO GAME METHOD AND DEVICE

This Appln. claims benefit of Provisional No. 60/102,622 filed Oct. 1, 1998.

### FIELD OF THE INVENTION

The present invention relates to electronic games such as wagering games or the like.

### BACKGROUND OF THE INVENTION

One of the earliest prize devices was the bagatelle or drop case. The game is played by dropping a ball or coin into a case which contains an arrangement of pins. The ball or coin moves through the case, striking the pins as it falls. In doing so, the path of the ball or coin is disrupted and randomized. Upon reaching the bottom of the case, the ball or coin falls into a compartment, the location of which indicates the prize won by the player.

For example, Buchanan (U.S. Pat. No. 503,942) discloses a device which uses a series of pins to indiscriminately guide a coin into a series of compartments located at the bottom of a case. Similarly, Breyfogle (U.S. Pat. No. 1,053,473) discloses a vending machine in which an arrangement of pins randomizes the path of a coin as it falls toward a series of slots. The slot into which the coin is finally deposited determines the prize the player has won.

However, these games suffer from some shortcomings. First, the gambling industry is well aware that attrition rate of games can be high if the player is not stimulated. In the games disclosed by the prior art, the playing surface never changes and there are no chances to progress toward a bonus or win a large payoff. Thus, a player will tend to tire of the game quickly.

Further, the gambling industry requires precise figures as to the player's chances of winning. Similarly, the gambling industry needs the ability to change the odds of winning to stimulate the players and to control the amount of payoff. However, the prior art games are random and indiscriminate in their outcomes and give no control over the odds of winning to the operator.

Thus, it can be appreciated that there is a need in the art for a novel drop case game which is more exciting and stimulating to the player and gives the operator accurate winning percentages while allowing the operator the flexibility and power to change the winning percentages as the operator desires.

### SUMMARY OF THE INVENTION

There is, set forth according to the present invention a method and device for a player to play a wagering game which includes a processor and a display controlled by the processor to display a pyramid or triangular shaped game board having an apex, a base and a plurality of pin locations depicted on the game board. In the preferred embodiment the pins are arranged in horizontal rows extending from the apex to the base. Also displayed at the base is a plurality of locations each of which defines an outcome for the game. Also according to the preferred embodiment at least one of the pins on the game board is designated as a horizontal shifting pin or point.

Means are provided for the player to make a wager to play the game and to prompt play. When play is prompted, a game character such as a point of light or an animated figure is displayed to fall from the apex to one of the locations at

2

the base. As the game character encounters pins, its path is deflected to one side or other based upon a random selection of either a right or a left deflection. If the character encounters a lateral shift pin, the game character path is diverted or shifted horizontally. Ultimately, the character reaches a base location to define an outcome for the game. Certain of the locations are designated as winning outcomes for which the player receives an award with the remainder designated as losing outcomes for which the player's wager is lost.

According to further embodiments of the game, a plurality of shift pins may be provided and randomly positioned for each game. Additionally certain pins may be designated as automatic losers whereby if they are encountered by the game character as it falls to the base terminates the further progression of the game character to the base. Still further, a pin in the game board display may be designated as a second game character generator. If this pin is encountered by the game character, a second game character is initialized and falls with the first game character to the base whereby two outcomes are obtained.

Additionally the player may be permitted to designate certain outcomes as bonus outcomes which, if that location is obtained by a game character, results in a bonus to the player.

### BRIEF DESCRIPTION OF THE DRAWINGS

These and other features and advantages of the present invention will become appreciated as the same becomes better understood with reference to the description, claims and drawings wherein;

FIG. 1 shows a display in one embodiment of the game;

FIG. 2 shows a display in another embodiment of the game;

FIG. 3 shows an example of a pay table for the game of FIG. 1 showing the pays based upon the number of units wagered; and

FIG. 4 shows an example of the probabilities assigned to each pin of the game for deflecting the game character to the right or left.

### DETAILED DESCRIPTION OF THE DRAWINGS

Turning to the drawings, FIG. 1 shows a display 10 the basic embodiment of the present invention. The display 10 can be any suitable electronic display device such as a video monitor, plasma display or other display devices as are well known in the art.

To control the display 10 and the features as hereinafter set forth, the device according to the present invention includes a computer processor (not shown) of a type well known in the art. The processor is programmed to control the display 10 and the other features of the game according to the present invention.

Also not shown in the drawings are means by which a player of the game may make a wager. These means are well known in the art and may consist of a token acceptor, cash validator and credit meter or the like. Accordingly, to play the game the player uses these wagering means to record a desired wager. It should be understood that where the game according to the present invention is played not as a casino game, that means are provided such as means for creating credits for a credit meter for wagering of fictitious credits.

The processor is programmed to generate the display 10 as shown in FIG. 1. The display 10 includes a pyramid or triangular game board 12 which has an apex 14 and a base 16. Between the apex 14 and base 16 there is included

depictions of a plurality of pins 18 the purposes of which will hereinafter become evident. At the base 16 there is also depicted a plurality of locations 20a-q each of which will define an outcome for the game. Each location 20a-q or several of the locations 20a-q may be represented, as shown, by icons 22a-f, each icon 22a-f defining a particular outcome for the game.

Before the game is played, the operator must make several decisions about the conduct of the game. First, the operator must determine the payoffs for each playing icon 22a-f. FIG. 3 illustrates the preferred payout schedule corresponding to each playing icon 22a-f shown in FIGS. 1 and 2. As seen in FIG. 3, some of the icons 22a-f representing outcomes in the preferred embodiment have no payoff. The payout schedule is stored in a data structure such as read-only memory or re-writeable storage media which the processor may read.

Second, the operator must set the probabilities that a game character such as a ball 24, as shown in FIG. 1, will be deflected to either the right or left side when it encounters pin 18. These probabilities are also stored in a data structure accessible to the processor. Thus, the operator has almost complete control over the path of the ball 24 as it is depicted falling from the apex 14 to the base 16 and one of the locations 20a-q. For example, if the operator wishes the path to be completely random, the ball 24 would have an equal probability (50/50) of being deflected to either side when it hits a pin 18. In the preferred embodiment, each of the pins 18 is selected to have an equal probability of deflecting the ball 24 to either the right or the left. According to another embodiment, however, the upper pins 18 have a higher probability of moving the ball toward the boundaries 26, 28 of the game board 12 and the lower pins 18 have a higher probability of moving the ball 14 toward the center of the game board 12. Because the playing icons 22a-f with the highest payout are located near the boundaries 26, 28 of the game board 12, the ball 24 moves toward the higher paying playing icons 22a-f while the ball 24 is near the apex 14 but then is deflected away from them as it moves down the game board 12. This gives the player the illusion that the player has a better chance of winning than actually occurs, makes the game more exciting, and stimulates the player's interest. FIG. 4 illustrates the alternate probabilities that the ball will be deflected to the right or left when it encounters each pin.

Referring to FIG. 1, in the preferred embodiment, one or more pins 18 are designated as lateral shift pins 30. The display 10 may be controlled to identify these pins 30 as by depicting them with a pointer. The purpose of the lateral shift pins 30 is to shift the path of the ball 24 horizontally over to the next adjacent pin 18 in the pin matrix of the game board 12. Thus, contrary to a pin 18 which merely deflects the ball 24 to one side or the other, the shift pins 30 displace the generally downward path of the ball from the apex 14 to the base 16 laterally to the left or the right depending upon the configuration of the shift pin 30, i.e. in the direction of the pointer. Thus, as described below, when the ball 24 encounters a shift pin, its path is laterally shifted to thus give the player more opportunities to obtain a winning outcome and to increase the excitement of the game.

The display 10 may also, according to other embodiments, be controlled to display other features on the game board 12. As shown in FIG. 1, the game board 12 may be shown to include a bonus icon 32 at a pin 18. At the beginning of gaming session, the processor will randomly place a bonus icon 32 at a pin 18 on the lowest row of the game board 12. If the ball 24 hits a playing icon 22a-f which is a winning outcome, i.e. a pay off is obtained, without hitting the bonus icon 32, the bonus icon 32 is randomly

placed on the next row of pins 18 up. If the ball 24 hits a icon 22a-f which does not pay off, without hitting the bonus icon 32, the bonus icon 32 remains in place. If the ball 24 hits the bonus icon 32, regardless of whether the ball 24 eventually hits a playing icon 22a-f which has a payoff, the bonus icon 32 is randomly placed on the lowest row of pins 18. When the bonus icon 32 reaches the top row pins 18 of the game board 12, the player wins a payoff which is determined by the operator and stored in a data structure accessible by the processor. In the preferred embodiment, the payoff is large to stimulate the player and encourage continued play. Moreover, the suspense generated by the progression towards a large payoff adds to the excitement of play.

A player begins a game by placing a wager. When the processor receives the signal that a wager has been received, the processor begins play by sending signals to the display 10 to represent the game character ball 24 falling from the apex 14 toward the base 16 and locations 20a-q containing the playing icons 22a-f. The processor also randomly locates the position of any shift pins 30 and bonus icons 32. As the ball 24 is shown falling down the game board 12 it encounters pins 18 which deflect the path of the ball 24 downwardly to the left or right. If the ball 24 encounters a shift pin 30 the path of the ball 24 is shifted laterally in the direction of the arrow of the shift pin 30. When the ball 24 reaches the base 16, the processor determines which location 20a-q the falling ball 24 contacts. The processor compares the result the playing icon 22a-f of the landing location 20a-q with the payoffs stored in the data structure to determine if the outcome of the game is a winning or a losing outcome. In one embodiment of the game, the playing icons 22a-f represent all the outcomes of the game. That is, the ball 24 will always hit a playing icon 22a-f, however, some of the playing icons 22a-f are designated as losing outcomes for which there is no payoff and some are designated winning outcomes for which there is a payoff.

If the processor determines that the ball 24 has landed at a location 20a-q defining a winning outcome, the processor controls the game to issue a reward to the player by dispensing coins from a hopper (not shown) or awarding credits to the player.

In an alternate embodiment of the game, some of the pins 18 may be indicated as stop pins 50 shown in FIG. 2. If the ball 24 encounters a stop pin 50, the travel of the ball 24 is terminated resulting in an immediate losing outcome for the player. In this embodiment, all playing icons 22a-f are designated as winning outcomes for which the player receives a reward.

Several features of the present invention are designed to capture the player's interest and stimulate play. The first is the doubler. This feature uses input means such as a button or a touch screen to allow the player to input to the processor which of the two highest paying playing icons 22a-f will pay an increased amount, e.g. double the normal payoff. Preferably, the payoff is large, as illustrated in FIG. 3, to stimulate the player and encourage play. The payoff is stored in a data structure accessible to the processor.

A second feature which can be incorporated into the game is a natural. A natural is a large payoff which occurs when the ball 24 hits one of the two highest paying playing icons 22a-f without hitting a shifting pin 30. Again, this payoff is preferably large to encourage play and create excitement and stimulation. This payoff is stored in a data structure accessible to the processor.

According to another embodiment, the processor at a start of a game may randomly assign to one or more pins 18 a

5

designation of a secondary game character pin 52 (FIG. 1). If the ball 24 encounters a second game character pin 52, a second game character, e.g. another ball 24, is displayed and shown falling through the game board 12 in the manner described above. On this occurrence the player would have two balls 24 in play thus increasing the chances of obtaining a winning outcome.

As yet a further feature, the player may have the option of initiating a plurality of game characters each of which progresses in succession down the game board 12. For example, the player may double his wager to activate a second game character.

While the game character is described as a depiction of a ball it is to be understood that the game character could be an animated skier with the pins 18 depicted as gates on a skiing course or the like.

While I have shown and described certain embodiments of the present invention, it is to be understood that it is subject to many modifications without departing from the spirit and scope of the appended claims.

What is claimed is:

1. A method for playing a pyramid style electronic game comprising:

a processor;

a player entering a wager;

said processor displaying a video display pyramid shaped game board, said game board including an upper apex and a lower base including distinct locations defined along the base;

the processor further displaying pins on the game board distributed between the apex and base and at least one of said pins denoted as lateral shift pin;

the player prompting play of the game whereupon the processor controls a display to show a game character falling from the apex toward the base on the game board, said character deflected to the right or to the left upon encountering said pins and said character shifting one pin to the right or left upon encountering a lateral shift pin and said character ultimately falling to one of said locations;

the processor determining the location which received said character and comparing the location to a predetermined schedule of winning and losing locations and whereupon said game character has encountered a winning location issuing a reward to the player.

2. The method of claim 1 wherein said processor displays a plurality of lateral shift pins upon the game board.

3. The method of claim 2 wherein said processor displays the direction the game character will shift when encountering said lateral shift pin.

4. The method of claim 3 wherein said processor randomly selects the locations of the lateral shift pins.

5. The method of claim 1 wherein said processor displays at least one stop pin upon the game board;

said processor determines whether said game character encounters said stop pin and whereupon the game character encounters a stop pin stops the progression of the game character and ends that specific game.

6

6. The method of claim 1 wherein said processor displays upon one of said pins a second game character indicator;

said processor determines whether said game character encounters said second game character indicator and whereupon said game character encounters a second game character indicator displays a second game character progressing the game board.

7. The method of claim 1 wherein said processor displays said pins in horizontal rows from the apex to the base and includes a bonus pin;

said processor determines whether said game character avoids said bonus pin as it progresses the game board and whereupon said game character avoids said bonus pin displays said bonus pin in a row nearer the apex during the following game;

and whereupon the bonus pin reaches the apex said processor issues a bonus to the player.

8. The method of claim 7 wherein said processor displays said bonus pin in a row nearest the base the game following said game character encountering the bonus pin.

9. An electronic game device comprising:

a triangular game board;

a processor;

said processor controls an electronic display;

said electronic display includes an apex, a base, pins between the apex and base, and a plurality of distinct locations along the base;

at least one of said pins designated a lateral shift pin;

means for a player to make a wager;

means for the player to prompt play of the game whereby said processor displays a game character progressing from said apex, through the game board, to a said location along the base;

said pins deflect said game character and said at least one lateral shift pin horizontally shifts said game character one pin to the right or to the left;

said processor determining the location which received said character and comparing the location to a predetermined schedule of winning and losing locations and whereupon said game character has encountered a winning location issuing a reward to the player.

10. The device of claim 9 wherein said processor displays a plurality of lateral shift pins upon the game board.

11. The device of claim 9 wherein said processor randomly selects the locations of the lateral shift pins.

12. The device of claim 11 wherein said processor displays the direction the game character will shift when encountering said lateral shift pin.

13. The device of claim 9 wherein said processor displays upon one of said pins a second game character indicator;

said processor determines whether said game character encounters said second game character indicator and whereupon said game character encounters a second game character indicator displays a second game character progressing the game board.

\* \* \* \* \*



US 20020163122A1

(19) **United States**(12) **Patent Application Publication** (10) Pub. No.: **US 2002/0163122 A1**  
Vancura (43) Pub. Date: **Nov. 7, 2002**(54) **METHODS AND APPARATUS FOR A CASINO GAME**

(52) U.S. Cl. .... 273/138.1; 273/256; 273/249; 273/237

(76) Inventor: **Olaf Vancura, Las Vegas, NV (US)**(57) **ABSTRACT**

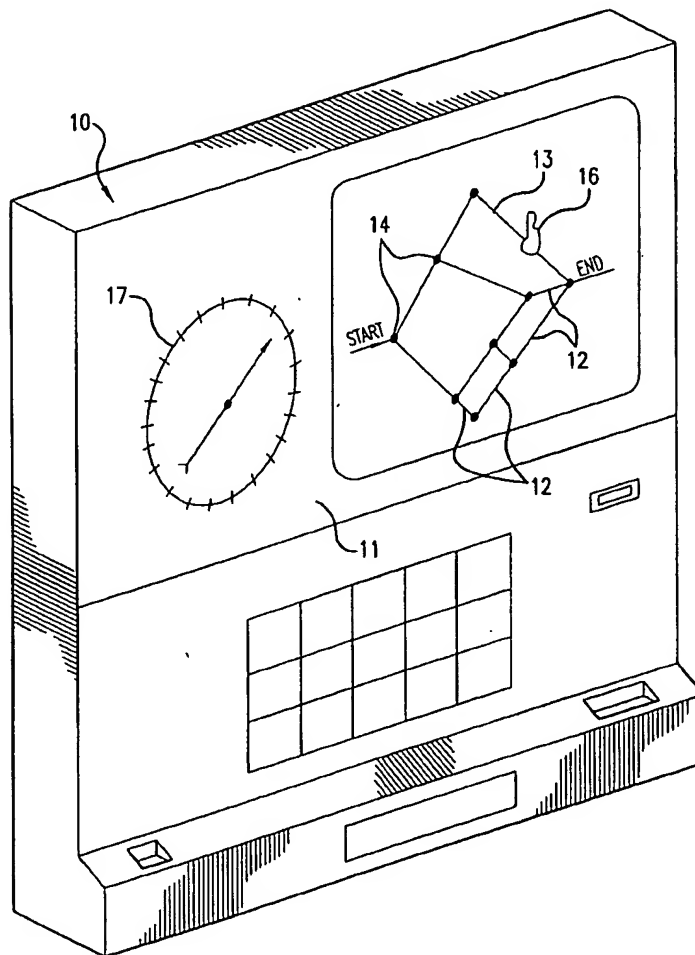
Correspondence Address:

**AARON PASSMAN****MIKOHN GAMING CORPORATION****P.O. BOX 98686****LAS VEGAS, NV 89193-8686 (US)**(21) Appl. No.: **10/177,489**(22) Filed: **Jun. 20, 2002****Related U.S. Application Data**

(63) Continuation of application No. 09/659,430, filed on Sep. 8, 2000, now Pat. No. 6,409,172.

**Publication Classification**(51) Int. Cl.<sup>7</sup> ..... **A63F 3/00**

A method for playing a game has the steps of establishing a plurality of paths, each of which have a plurality of squares including a start square, an end square, and a plurality of value squares. Randomly traversing the paths to afford the possibility of two or more moves to reach the end square. Allowing a player to select one of the paths. Moving along the player selected path randomly, while awarding the player the values associated with squares landed upon. The randomness is by the steps of spinning a spinner, rolling a die or dice, employing a wheel, flipping a coin, or the use of a random number generator. The step of establishing a plurality of paths, each having a plurality of squares includes using a stop square, squares which cause additional movement. The steps of establishing intersecting paths or establishing one or more squares having a game associated with them are practiced. The method is in a casino game and a bonus game for a base game.



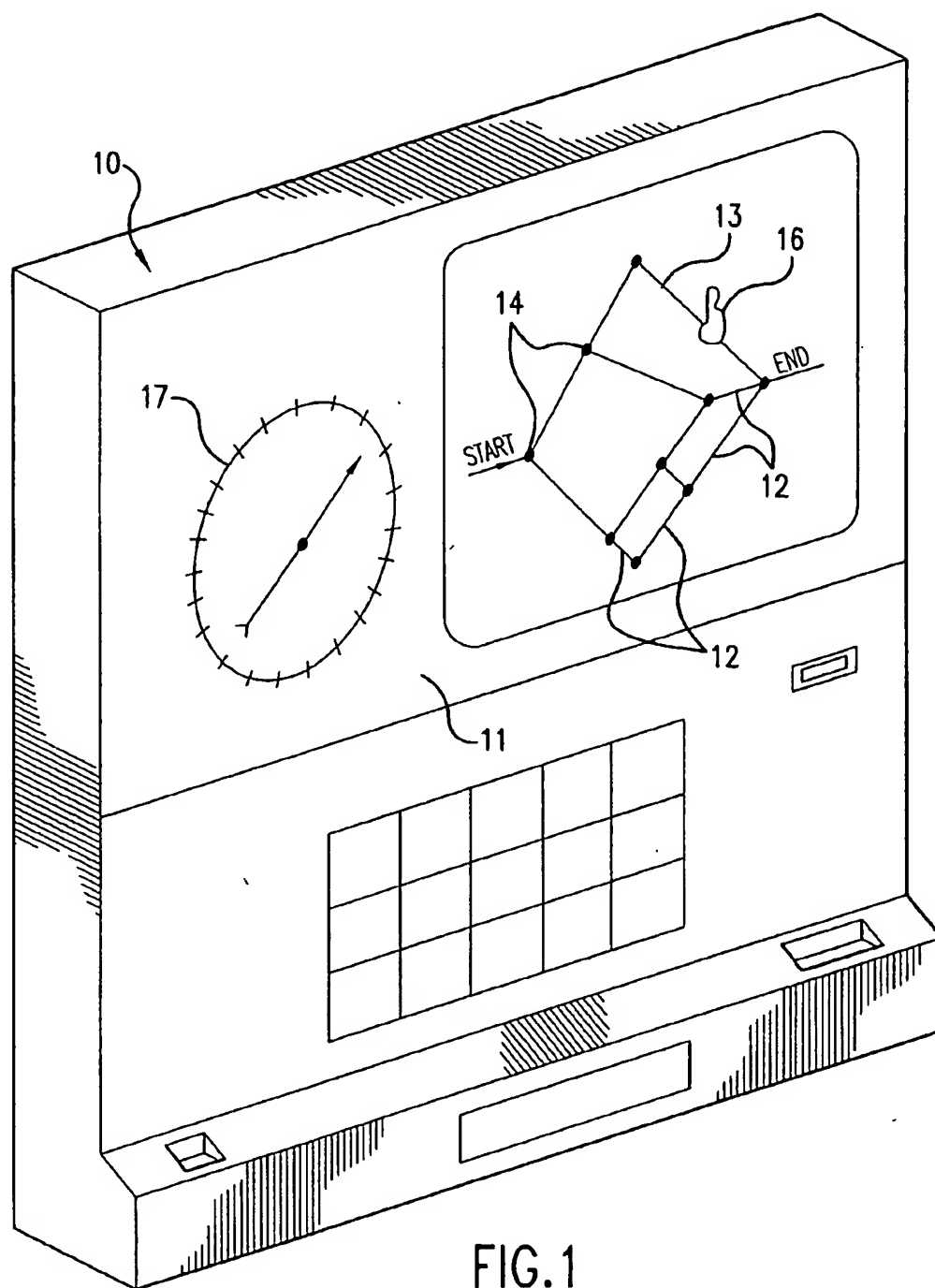


FIG. 1

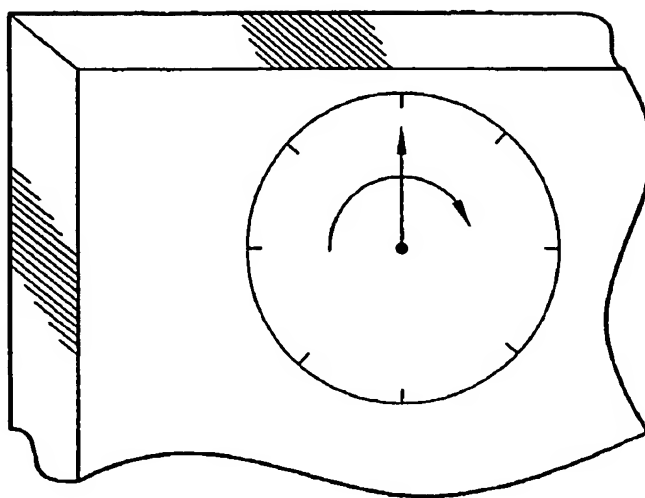


FIG. 2

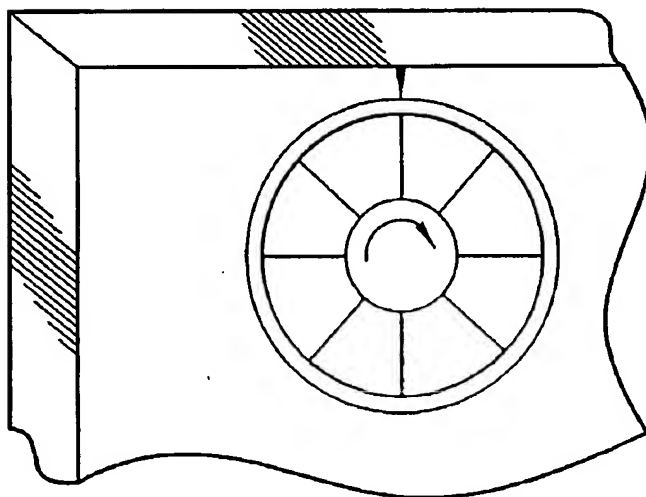


FIG. 5

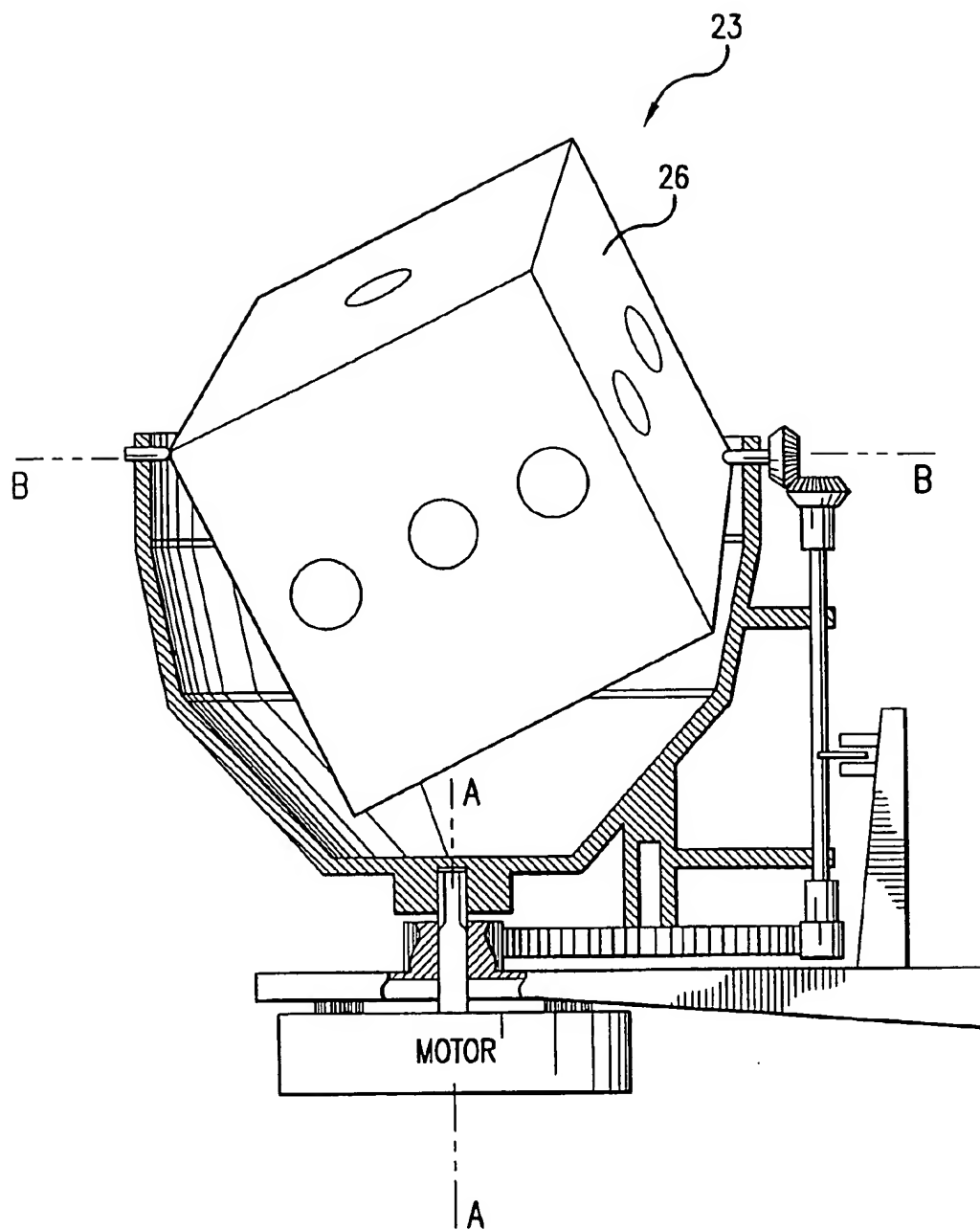


FIG.3

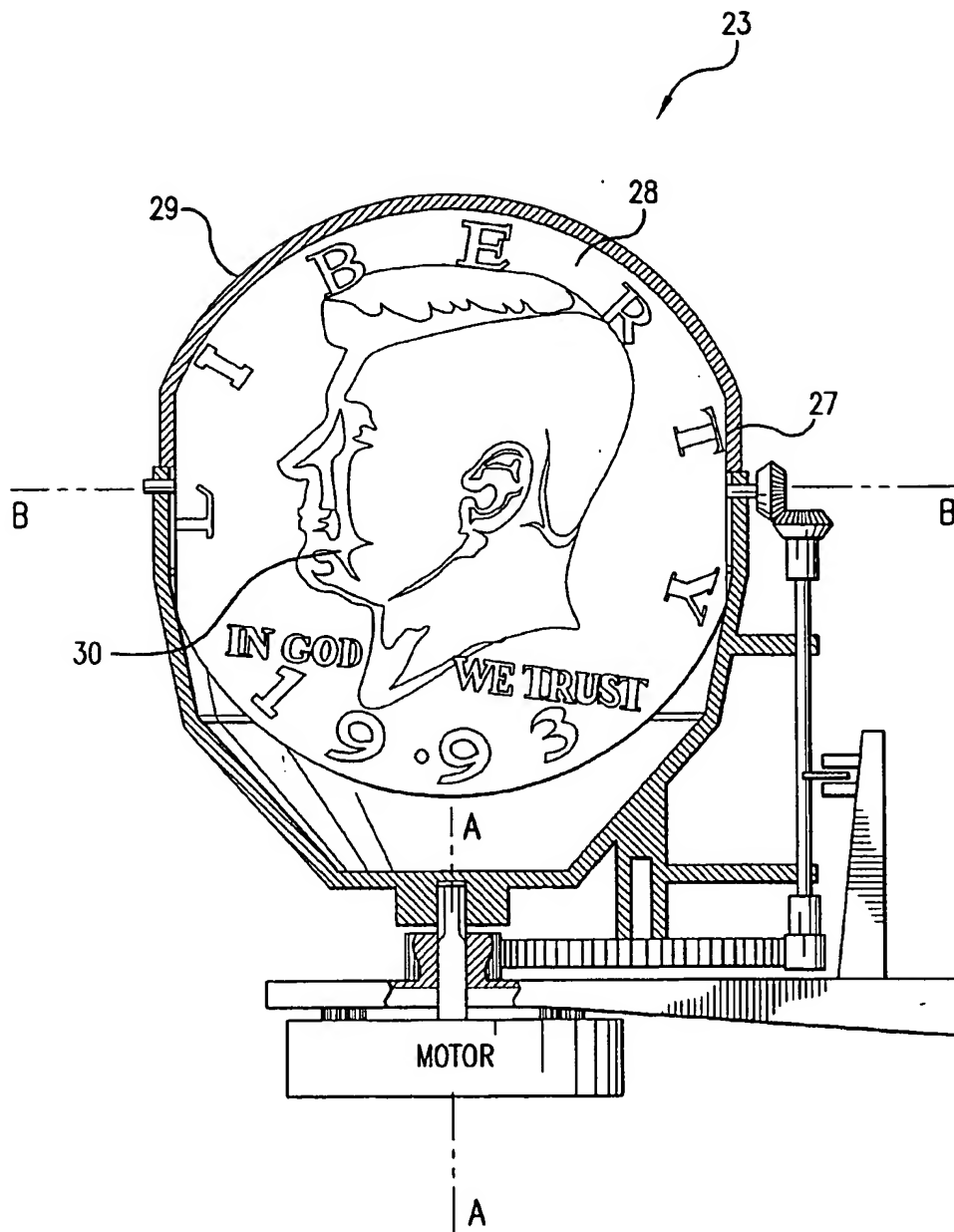


FIG. 4

WIN 0	WIN 100	WIN 80	WIN 0
START			END
WIN 50	WIN 60	WIN 30	WIN 40

FIG.6

START	WIN 20	WIN 30	WIN 40	WIN 50	WIN 60	END
START	WIN 0	WIN 0	WIN 0	WIN 0	WIN 200	END
START	WIN 0	WIN 50	WIN 95	WIN 50	WIN 0	END
START	WIN 0	WIN 40	WIN 60	WIN 45	WIN 50	END

FIG.7

START		
WIN A1	WIN B1	WIN C1
WIN A2	WIN B2	WIN C2
WIN A3	WIN B3	WIN C3
WIN A4	WIN B4	WIN C4
DECISION NODE		
WIN D1	WIN E1	WIN F1
WIN D2	WIN E2	WIN F2
WIN D3	WIN E3	WIN F3
WIN D4	WIN E4	WIN F4
END		

FIG.8

START NODE		
WIN 30	WIN 23	LOSE 40
WIN 30	WIN 73	WIN 100
WIN 30	LOSE 22	LOSE 67
WIN 30	WIN 45	WIN 150
WIN 30	WIN 20	LOSE 30
END NODE		

FIG.9

START	WIN 10	WIN 20	WIN 30	WIN 40	WIN 50	WIN 60
STOP						
END	WIN 60	WIN 50	STOP	WIN 30	WIN 20	WIN 10

FIG.10

## METHODS AND APPARATUS FOR A CASINO GAME

### CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This is a continuation of U.S. Ser. No. 09/659,430, U.S. Pat. No. 6,409,172 with an issue date of Jun. 25, 2002.

### STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable

### REFERENCE TO A "MICROFICHE APPENDIX"

[0003] Not Applicable

### BACKGROUND OF THE INVENTION

[0004] 1. Field of the Invention

[0005] The present invention relates to casino games and, in particular, to improvements in the methods of playing bonus games on slot machines.

[0006] 2. Description of Related Art Including Information Disclosed under 37 CFR 1.97 and 1.98

[0007] Slot machines have become the most important contributor to revenue on casino floors. Among slot machines, those with a bonus game have become especially popular. Typically in these machines, a player plays the underlying game (sometimes referred to as the base game) with the usual pays for predefined combinations of symbols.

[0008] Occasionally, the player will qualify for a bonus event. This is usually triggered through the alignment of one or more special symbols (sometimes referred to as trigger symbols) as an event which initiate the bonus game. Hence, the bonus game is generally a somewhat rare and special occurrence that affords the player an opportunity to participate in an ancillary component of the slot machine with an associated award. Usually, no additional wager is required; the bonus game is an opportunity for the player to earn an additional award risk-free.

[0009] The bonus award may be distributed by the slot machine in various ways, including adding to the base game credits, the use of an external "top-box", or the use of a second-screen in the case of video. Too, the bonus game may simply be a random choice of several prizes, one or more free base games, and so forth.

[0010] By use of the terms bonus game, there is intended no limitations to any particular form of bonus award. Rather, reference to a "bonus game" as one which is different than the traditional base game play. The bonus game may be housed separately from the reels (for example, in a spinning-reel slot machine with a top-box bonus), or may be simply on an additional screen (for example, in a video-reel slot machine). Too, for the purposes of the teachings herein, the manner and equipment that initiates a bonus game (e.g., combination of special symbols as described above or other methods) are immaterial to the present disclosure.

[0011] There continues to be a need to enhance the bonus experience for slot machine players. In particular, players desire a feeling of control over the outcome of the bonus game. This may be accomplished in fairly crude ways, such

as selecting one of five elements to reveal an award. However, such crude ways may lead quickly to apathy on the part of sophisticated and/or regular players, who are always looking for challenge and variety.

[0012] The feeling of control may also be accomplished by allowing the player to additionally wager during the bonus game. For example, the Monopoly® Once Around game by WMS Gaming utilizes a Monopoly board and has the player start at "Go" and, using the outcome of a pair of dice, traverse the periphery of the board once. Before beginning, players are given the opportunity to "buy" (for an additional wager) houses and hotels on the various properties, in the hopes that they will be landed upon for an increased award. The result is that an unlucky player may actually be a net loser during the bonus game.

[0013] Another manner in which a bonus game may afford the player control is via the use of a strategy game. For example, the use of Yahtzee® poker dice in games by Mikohn Gaming, Inc. of Las Vegas, Nev. as a bonus game has proved very popular. However, insofar as games of strategy generally afford considerable replay value, the rules of the game must nevertheless be learned. As such, the time required assimilating a "learning curve" by the casual player is best minimized.

[0014] Thus, there exists a need for bonus games that have essentially no learning curve, yet afford considerable replay value. In particular, a need exists for a bonus game in which the player is given distinct and meaningful choices, but whose outcome is nevertheless controlled in such a fashion as to ensure the operator's expected margin for the slot machine.

### BRIEF SUMMARY OF THE INVENTION

[0015] The solution, as disclosed herein, may include a bonus game with multiple paths emanating from a common node. The multiple paths represent, both mathematically and from a game-flow point of view, meaningful choices the player may make while participating in the bonus game. In this fashion, the player keeps several desirable attributes including control over the direction of the bonus game and, as will be described shortly, relative risk and/or volatility of the game. The operator, meanwhile, retains control over the expected value of the bonus award, hence house advantage of the overall machine.

[0016] It is an advantage of the present invention that the player is given distinct strategic choices, while the outcome is nevertheless controlled in such a fashion as to ensure the operator's house advantage. It is a further advantage of the present invention that the bonus games described herein have almost no learning curve yet still afford considerable replay value.

[0017] As a preferred embodiment, the player is offered the choice of a plurality of paths, a path being defined as being traversed in at least one but possibly more moves. Herein each move is defined by a "square" but the geometry of the space moved to is not necessarily important as it is just a place or position having a value or in some cases no value or a loss of value.

## BRIEF DESCRIPTION OF THE DRAWING

- [0018] FIG. 1 is an illustration of an embodiment of a casino game of chance.
- [0019] FIG. 2 is a partial view of a casino game spinner used for random selection.
- [0020] FIG. 3 is a partial view of a casino game die used for random selection.
- [0021] FIG. 4 is a partial view of a casino game coin used for random selection.
- [0022] FIG. 5 is a partial view of a casino game wheel used for random selection.
- [0023] FIG. 6 is an example showing a form of game play.
- [0024] FIG. 7 is another example showing another form of game play.
- [0025] FIG. 8 is a further example showing an alternate form of game play.
- [0026] FIG. 9 is yet one more example showing a still further form of game play.
- [0027] FIG. 10 is a still further example showing yet another form of game play.

## DETAILED DESCRIPTION OF THE INVENTION

*Inital Consideration*

[0028] As an example of the present invention, consider the following topology in which the player begins at "Start" on the left-hand side. The player must choose which path (upper or lower) to take to the "End" square, see FIG. 6 for example.

[0029] A random "spinner", of the type conventionally known and programmable for random disposition (with equal probability), is used to roll each of the numbers 1 through 4; e.g., in a video format, a quartered pie-wedge circle may be depicted with overlaid spinner.

[0030] After the player has chosen a path (say, the lower), the spinner is spun, and a marker traverses the path. For example, if the first spin ended in a 2, the marker would depict movement from "Start" to the "Win 60" square. The player would be awarded 60 credits. The spinner is spun again, and play continues until the marker reaches the "End" square.

[0031] The expected value hereafter "EV" for each path may be calculated by skilled artisans using, e.g. combinatorial analysis or Monte Carlo simulation. Below please find the calculated results for the above example. Shown is the probability herein "P" of landing on each of the 4 squares along either path (note that the probabilities sum to a value greater than 1, reflecting the fact that multiple squares may be landed upon during traversal of a given path):

$$[0032] P(1) = \frac{1}{4} = \frac{64}{256}$$

$$[0033] P(2) = \frac{1}{4} \times \frac{1}{4} + \frac{1}{4} = \frac{80}{256}$$

$$[0034] P(3) = \frac{1}{4} + 2 \times \frac{1}{4} \times \frac{1}{4} + \frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} = \frac{100}{256}$$

$$[0035] P(4) = \frac{1}{4} + 3 \times \frac{1}{4} \times \frac{1}{4} + 3 \times \frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} + \frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} = \frac{125}{256}$$

[0036] Thus, the EV for the upper path is equal to  $(\frac{80}{256}) \times 100 + (\frac{100}{256}) \times 80 = 62.5$ . The EV for the lower path is equal to  $(\frac{64}{256}) \times 50 + (\frac{80}{256}) \times 60 + (\frac{100}{256}) \times 30 + (\frac{125}{256}) \times 40 = 62.5$ .

[0037] Thus, a game has been constructed that affords the player the option of choosing a path to take, while affording the house a fixed expected value regardless of which path the player chooses. In particular, the player may choose a path with greater volatility or less volatility, but the game is assured of a known, pre-calculated expected value regardless of the strategy adopted by the player. As used herein, volatility relates to the standard deviation of the distribution of possible values about the expected value.

[0038] As used herein, volatility relates to the standard deviation of the distribution of possible values about the expected values. A simulation of the game confirms the expected values for both paths and suggests a standard deviation of approximately 54 units for the upper path and 31 units for the lower path. Hence, in this case, the upper path is more volatile (in terms of possible outcomes after path traversal) to the player.

[0039] If desired, another even more volatile "path" with "Win 0" in positions 1, 3, and 4, and "Win 200" in position 2 may be constructed. It can be confirmed, using the aforementioned probabilities, that the EV for this new path is also 62.5. The associated standard deviation is approximately 93.

[0040] The examples given above are for specific paths (of length 5), a specific random means of traversing the path (random and equal distribution of 1 through 4 squares per turn), and a specific EV for each path. However, other path lengths and random means and approaches are possible, as skilled artisans will appreciate. Hence, the foregoing is meant as an illustration via a specific example but is not intended in any way to limit the teachings herein disclosed.

[0041] Too, the aforementioned example had the player choose the path at the beginning. It is within the scope of this invention to have the choice occur later. For example, the player may start down a given path, and upon reaching a "fork" be given a choice at that juncture. As used herein the terms along a path such as, juncture, fork, node and the like all relate to decision points or choices for the player and may include more than two alternatives. For example, three alternatives along a path could be angle left, angle right or go straight ahead.

[0042] As an example, a design choice may be to use more than two possible paths. This gives the player even more choices, in a controlled fashion, and thus further accommodates different styles of play. Consider the following case in which the player begins at "Start" on the left and is offered four horizontal paths to take to "End" on the right. A coin is flipped with heads moving the player forward 1 square, and tails moving the player forward 2 squares, see FIG. 7 for example.

[0043] A calculation similar to that described above yields the following results.

$$[0044] P(1) = \frac{1}{2} = \frac{16}{32}$$

$$[0045] P(2) = \frac{1}{2} + \frac{1}{2} \times \frac{1}{2} = \frac{24}{32}$$

$$[0046] P(3) = 2 \times \frac{1}{2} \times \frac{1}{2} + \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{20}{32}$$

$$[0047] P(4) = \frac{1}{2} \times \frac{1}{2} + 3 \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} + \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{22}{32}$$

$$[0048] P(5) = 3 \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} + 4 \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} + \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{21}{32}$$

[0049] Inserting the appropriate values from each of the four paths yields an EV of 131.25 regardless of path chosen. In this manner, the player may be given an arbitrary number of paths; each constructed in conformity with the teachings herein provided. It is an advantage of this invention that the numbers of paths, and the values of their squares, afford considerable flexibility in game design.

[0050] Although the preferred embodiment uses paths with identical lengths, another embodiment may use paths of differing lengths. For example, path "A" may have 10 steps while path "B" may have only 6 steps, and so forth. Again, the probabilities of landing on each path square may be determined, so that the calculated theoretical EV associated with each path is equal or approximately so.

[0051] It is another advantage of this invention that the random ways of traversal are design choices. For example, a design choice may be, as part of a random means of movement, to afford the possibility of moving 0 squares in some instances. In the case of no movement, the player may again be given the value of the square currently "stuck" upon, or may simply stay upon the square without again being awarded the square's value. In either case, the respective probabilities of landing on each square may be calculated to determine the resultant EV associated with each path.

[0052] While the preferred embodiment uses identical ways of traversing each path, in another embodiment different ways of traversing each path are prescribed. For example, path "A" may be traversed by rolling a single die and moving forward the number of steps shown, while path "B" may be traversed by throwing two dice and moving forward the sum of the steps. Clearly, other possibilities exist as will be apparent to one skilled in the art.

[0053] Furthermore, note that the EV of each path need not be mathematically identical. The general teachings of this invention are meant to allow the player flexibility over choice of outcomes in a controlled fashion. It is within the scope of this invention to construct different paths with expected values that are not identical, and in some cases quite dissimilar, yet still provide for an overall game return within a known range acceptable to the operator.

[0054] As an example of the foregoing, note that a typical slot machine game may be described as having a total return "ERtot" per unit wagered. ERtot may be made up of contributions from the base game ERbase and one or more bonus games ERbonus (for simplicity only one bonus game will be considered in the following description), as follows:

$$[0055] \quad ER_{tot} = ER_{base} + ER_{bonus}$$

[0056] Where the house advantage "HA" is defined to be the following:

$$[0057] \quad HA = 1 - ER_{tot}$$

[0058] For a typical bonus game with frequency  $f$ , we may calculate ERbonus as:

$$[0059] \quad ER_{bonus} = f \times EV_{bonus}$$

[0060] For example, consider a game with  $ER_{base} = 0.6$ ,  $f = 0.005$ , and  $EV_{bonus} = 60$ , we find  $ER_{bonus} = 0.3$  and  $ER_{tot} = 0.9$ . Thus, the house advantage is 10%. In the teachings of a multiple-path bonus herein, a bonus game is constructed with two possible paths each having  $EV_{bonus} =$

60. In this way and as intended, the overall house advantage remains always 10% regardless of path chosen by the player in the bonus game.

[0061] However, for instance, one path may have an  $EV = 60$  while the other may have an  $EV = 64$ . Then,  $ER_{bonus}$  is bounded by the limits  $0.3 (= 0.005 \times 60)$  and  $0.32 (= 0.005 \times 64)$ . Hence,  $ER_{tot}$  is bounded by the limits 0.9 and 0.92, depending on the path selected by the player. The house advantage, though not constant, is thereby assured to be in the range of 8% to 10% and remains in a controlled fashion. Alternatively, one path may have an  $EV = 30$  and another  $EV = 70$ , creating a house advantage assured to be in the range 5% to 25%. The total range is therefore 25%–5% = 20%. If a player chooses randomly, the resultant house advantage will be the mean of the paths, in this case 15%. The difference between the player selected "best" path and the mean path in this example is therefore 15%–5% = 10%.

[0062] While the foregoing has been described in terms of two paths, the number of paths, their associated  $EV_{bonus}$ , the frequency of the bonus (and other bonuses), the relative contributions of  $ER_{base}$  and  $ER_{bonus}$ , and so forth, are all design choices. Hence, the foregoing is meant to be illustrative and not limiting in nature. What is taught is the use of an overall game comprised of a base game and one or more bonus games. The bonus game has multiple paths, each path offering a potentially different expected value, but which nevertheless combined with the relative frequency of a bonus game, provide for an expected return on the overall game within calculable and acceptable limits.

[0063] Also, while the foregoing has been presented in terms of a bonus game, we note that the teachings of this invention may likewise be used as a game of chance in and of themselves. In this case, utilizing the formalism described above,  $ER_{base} = 0$  and  $f = 1$ . Hence,  $ER_{tot} = ER_{bonus} = EV_{bonus}$ . To assure a house advantage, clearly  $ER_{tot}$  must be less than 1. Hence,  $EV_{bonus}$  (the expected value of the bonus game per unit wager) must likewise be less than one.

[0064] Hence, in the example given earlier in which the EV of the game is 62.5, a possible method of implementing as a standalone game of chance is to require the player to wager, say 75 units to play the game. Then the normalized  $EV_{bonus}$ , per unit wager, is  $62.5/75 = 0.8333$ . The resulting house advantage is 16.67%.

[0065] We have shown therefore, that the method herein applies not only to bonus games but to games of chance in general. In particular, the same set of paths may be used as either a bonus game or a standalone game of chance. While the foregoing has described one method of utilizing the teachings herein in the form of a standalone game of chance, other design choices will be appreciated by those skilled in the art. Therefore, the preceding example should be considered an illustration only, and not meant to limit the teachings herein.

[0066] The teachings herein allow for considerable flexibility in designing pathways. As described, this includes the number of paths between the start and end, and their topology. While the above examples have the Start square as a node (with a choice), the Start square could also have no choice, leaving until later the opportunity for the player to make a decision.

[0067] The random means of traversing each path, is also a design choice. Examples can include the spin of a wheel or arrow, the use of a wheel, the roll of dice, the flipping of a coin, random number generators, etc. Chance as used herein includes the mentioned random means, and any form of random selection whether specifically mentioned or otherwise so long as the result is arbitrary.

[0068] In a preferred embodiment, the paths may have decision nodes, which allow for additional decisions to be made. For example, consider the following schematic path structure (in this example, wherein the values A1, A2, . . . , F3, F4) are not specifically portrayed, see for example FIG. 8.

[0069] Here, the player begins at the Start node and chooses one of three paths (A, B, or C) to traverse. Upon reaching the Decision node, the player must again choose one of three paths (D, E, or F) to follow. It should be appreciated that whether the player is stopped at the Decision position, or allowed to continue moving through this zone uninterrupted (while selecting the next path of D, E, or F) is a design choice. Furthermore, it may be desirable (when used as a bonus) to have the player complete the first section of the bonus (to the Decision node) upon first visiting a bonus game, only to return to play of the base game. Upon further qualification for a bonus, the player resumes the journey through the Decision node and selects the next path to take. Other variations upon this general approach are also possible, including the use of multiple intermediate positions.

[0070] Lastly, we note that while we have presented each of the squares in a "winning" capacity (i.e., can't lose), it is also possible to have some squares as net losers (i.e., a negative amount is "won"). For example, consider the following two-path game in which a single coin is flipped for random movement, with heads moving forward one square and tails moving forward two squares, see for example FIG. 9.

[0071] As before, we find the following probabilities of landing on individual squares:

$$[0072] \quad P(1) = 1/32$$

$$[0073] \quad P(2) = 2/32$$

$$[0074] \quad P(3) = 20/32$$

$$[0075] \quad P(4) = 22/32$$

$$[0076] \quad P(5) = 21/32$$

[0077] The expected value, regardless of path chosen, is equal to 95.5625. Showing a method whereby the player may choose a path that has possible "losing" elements in addition to "winning" elements. Thus, what is shown is a method whereby non-risk-averse players wishing to gamble with a volatile path (and possibly losing) are also rewarded handsomely with increased awards on the potential winning squares.

[0078] In another preferred embodiment, certain squares are designated "stop" squares. These are squares in which the player pauses upon landing on the square. As such, the player stops on the square instead of traversing it in the normal fashion. The next move continues with the player initiating movement from the "stop" square. For example, consider FIG. 10 as a sample path.

[0079] If a single die is used to define moves around the path, then the following illustrative example demonstrates how the "Stop" square functions. The player begins at Start. If the first die roll is a 3, the player moves to the "Win 30" square. If the next die roll is a 2, the player moves to the "Win 50" square. If the next die roll is a 4, the player moves to the "Stop" square and stops there. If the next die roll is a 1, the player moves from "Stop" to the "Win 10" square. With a next die roll of 6, the player moves to the second "Stop" square. A final die roll of 4 ends the game.

[0080] Several paths of this type may be chosen among. The number and location of the Stop squares is a design choice. Too, the Stop squares, much like the Start, End, and Decision Node squares may also have a value, or other events, associated with them.

[0081] It is also within the scope of this invention to have designated squares act to move the player to other squares. This may be accomplished, e.g., via "Move ahead 3 squares" or "Go back 1 square" types of instructions. Alternatively, a square on path A may direct the player to move to a square on an alternate path (say B), thus further adding an element of surprise and suspense.

[0082] Lastly, while the examples above suggest monetary, or credit, wins/losses associated with each square, the extension to other items is also made. For example, certain squares may prescribe the play of an additional game. Provided the associated EV of such a game can be calculated, landing on the square and awarding the result of the game is mathematically equivalent to simply awarding the associated expected EV for the game. That is to say, the play of an additional game may be used to deliver a desired EV, rather than simply awarding the player a fixed amount. Note that the game may award a range of values and/or may involve strategy.

[0083] As another example, certain squares may allow players to acquire items that may later be exchanged for value. For example, consider a dessert-themed game in which predetermined squares allow the player to accumulate scoops of ice cream. Upon completion of the path, the player may receive an additional award based upon the number of scoops of ice cream collected. Again, the expected value of the path may be calculated traditionally, and includes as part of the calculation a determination of the value of the collected items.

[0084] Alternatively, the player may acquire items by several other means. These include random "gifts" as well as purchase via an additional wager. For example, after each movement, the player may have a 10% chance of being offered the sale of "fine art" to later be sold at auction (i.e., exchanged for value) upon completion of the game.

[0085] Also, the player may acquire privileges. For example, upon a certain chance outcome (e.g., a roll of 6 on a single die), the player may buy the privilege of choosing the next square landed upon. As another example, consider the case in which a player landing on a prescribed square may buy the opportunity to double all remaining square values. The means of acquiring items or privileges, whether randomly, by squares landed upon, by purchase, and so forth, is a design choice, and the foregoing is not meant to be limiting.

[0086] While the examples illustrating the play and different options for the casino games are explained throughout

the preceding disclosure, skilled artisans will appreciate that many variations of the execution will be possible. The specific examples should not be considered limiting and the particular casino game equipment shown in FIG. 1 is merely for depiction of but one example of form. In that regard, there is shown a casino game of chance 10 for at least one player. The casino game of chance 10 has a game surface 11 accessible and visible to the player to play the casino game of chance 10. A plurality of paths 12 on the game surface are arranged for the player, currently shown on selected path 13. A plurality of nodes 14 represent points at which the player must choose which subsequent path to traverse. The plurality of paths 12 and nodes 14 can be in the form of a lighted display or video screen as shown for example in FIG. 1. In a well known manner in gaming the game surface 11 may be an interactive structure such as a touch screen, if a video, for the purpose of path selection. As disclosed throughout the preceding detailed description there may be value positions, intersections, and other positions along the paths 12 as part of a particular game.

[0087] During play there is a need to show the position on the path 13. In the preferred embodiment, movable indicia 16 on the game surface 11 show the position on the player selected path 13. In the physical embodiments of the casino game of chance 10, the movable indicia 16 can include tokens, graphic representation, icons and video depictions depending on the chosen interactive structure for the casino game of chance 10.

[0088] A mechanism of chance 17 carried on the game surface 11 is available to the player. The mechanism of chance 17 is for determining the random movement of the indicia 16 along the player selected path 13 and for awarding the player any values associated with positions along the selected path 13. As set forth herein before the mechanism of chance 17 can include, spinners, FIG. 2 dice, FIG. 3 wheels, FIG. 4 for random number generators or a coin for flipping, FIG. 5 etc. The expected value for each possible player choice of paths is designed to preserve the house advantage and make the casino game of chance 10 commercially viable.

[0089] FIG. 1 shows the bonus game atop a slot machine in a conventional manner according to the way in which bonus games are provided in the casino games discussed in the background of this disclosure. FIG. 2 is a view of a spinner used as a random selection means with the present bonus game the spinner would be rotated during game play by a motor or virtually on a video by control of the random number generator in the casino game. Similarly, FIG. 3 is a view of a die used for random selection. Motorized die 26 or virtual die on a video screen for random number selection are well known in casino equipment. U.S. Pat. No. 5,803, 451 has the Starpoint IDU Modular Dice Mechanism of FIG. 3 and the description therein is incorporated herein by reference and made a part hereof. The preferred automatic mechanism for each spinning die 26 is commercially available from Starpoint Electric Limited of Morden, Surrey in the United Kingdom.

[0090] The die 26 can easily be replaced by a coin 27 as in FIG. 4 used for random selection. In particular, instead of the die 26 a two-sided coin 27 can be mounted to spin about its A-A or B-B diameter. The die 26 or coin 27 would be spun by output of the random generator. The coin 27 has

opposed sides with a head or tail. FIG. 5 is partial view of a game having a wheel used for random selection. Wheels may be spun by the dealer, a motor or as a virtual video wheel; the latter two wheels are typically controlled by a random number generator in many types of casino equipment. U.S. Pat. No. 5,823,874 has a bonus indicator in the form of a rotating bonus wheel that can be caused to spin automatically or in response to some action by a player, e.g., pushing a button so the primary reels indicate one of a predetermined plurality of indicia. When the wheel stops, a pointer indicates the bonus payout to be awarded to the player. Be it a wheel FIG. 5 or a spinner FIG. 2 the idea of a random selection is common in this field.

[0091] Those skilled in the art will appreciate the plethora of possibilities associated with accumulating items and/or privileges that may increase in value, lose value, or otherwise play a part in the expected value for the bonus sequence. What is material is the use of acquisition by the player of certain items and privileges, each of which affects the potential outcome of game, but which nevertheless allows for the calculation of a controlled and limited range of expected values for the game.

What is claimed:

33. A method for playing a casino game of chance for a bet with random entry from an underlying slot machine to a bonus game of the casino game of chance, the method for playing a casino game comprising the steps of:

- a) establishing a plurality of paths in the play of the bonus game of the casino game of chance, each of which path is comprised of a plurality of positions;
- b) establishing a random means of traversing the paths in the play of the bonus game of the casino game of chance;
- c) presenting with the random means the possibility of two or more moves being required to complete the bonus game;
- d) allowing a player to select one of the paths in the play of the bonus game of the casino game of chance;
- e) moving according to the random means along a selected path by the player;
- f) providing at least one position having an outcome;
- g) awarding the player values based upon the outcome associated with positions landed upon, and
- h) relating a random frequency of the bonus game to the probability of landing on each position and to the value of each position so a predetermined range for a house advantage is maintained in the casino.

34. The method of claim 33 with the step of including one or more value positions along the paths in the play of the bonus game of the casino game of chance.

35. The method of claim 33 wherein the random means is performed by one of the following steps, spinning a spinner, rotating a wheel, rolling at least one die, flipping a coin, using a random number generator.

36. The method of claim 33 with the step of establishing a plurality of paths, each of which paths is comprised of a plurality of positions and with the step of having one of the positions as a stop position on one of the paths in the play of the bonus game of the casino game of chance.

37. The method of claim 33 wherein landing on certain positions along the selected path in the play of the bonus game of the casino game of chance causes additional movement.

38. The method of claim 33 by establishing intersecting paths in the play of the bonus game of the casino game of chance.

39. The method of claim 33 with the step of establishing one or more positions along the selected path in the play of the bonus game of the casino game of chance having an associated game.

40. The method of claim 33 wherein the awarding the player values step includes the step of selecting one of the following values: money, credits, privileges, items, another game, other events, other paths.

41. A method for playing a casino bonus game for a casino base game, comprising the steps of:

- a) establishing in the play of the casino bonus game a plurality of paths, each of which paths includes a plurality of positions with at least one value position there between;
- b) moving along a player selected path provided with a random selection;
- c) providing at least one position having an outcome;
- d) awarding the player values based upon the outcome associated with positions landed upon, and
- e) relating a random frequency of the bonus game to the probability of landing on each position and to the value of each position so a predetermined range for a house advantage is maintained in the casino.

42. The method of claim 41 wherein the step of moving includes a stop position.

43. The method of claim 41 wherein the step of moving includes random selection of positions that cause additional movement.

44. The method of claim 41 wherein the step of establishing plural paths includes at least one position common to the plural paths whereat the paths intersect.

45. The method of claim 41 wherein the establishing step includes one or more value positions having an associated game.

46. The method of claim 41 wherein the awarding the player values step includes the step of selecting one of the following values: money, credits, privileges, items, another game, other events, other paths.

47. A method for playing a casino game of chance, comprising the steps of:

- a) establishing in the play of the casino game a plurality of paths, each having at least two positions;
- b) allowing a player to select one of the plurality of paths in the play of the casino game of chance;
- c) moving along one of the plurality of paths selected by the player in step b) according to chance;
- d) providing at least one position having an outcome;
- e) awarding the player values based upon the outcome associated with the selected path in the play of casino game of chance, and
- f) relating a random frequency of the bonus game to the probability of landing on each position and to the value

of each position so a predetermined range for a house advantage is maintained in the casino.

48. The method of claim 47 for playing a casino game of chance by playing a base game and a bonus game in the play of the base game and the bonus game of the casino game of chance.

49. The method of claim 48 for playing a casino game wherein the step of controlling the house advantage provides a total range thereof of about twenty percent.

50. The method of claim 48 for playing a casino game wherein the step of controlling the house advantage includes a range for the player selected best path to the player selected mean path of about fifteen percent in the play of the base game and the bonus game of the casino game of chance.

51. The method of claim 47 wherein the step of moving according to chance is selected from these steps, spinning a spinner, rotating a wheel, rolling at least one die, flipping a coin, using a random number generator.

52. The method of claim 47 wherein the step of establishing a plurality of paths in the play of the casino game of chance, each of which is comprised of a plurality of positions includes using a stop position.

53. The method of claim 47 wherein landing on certain positions causes additional movement.

54. The method of claim 47 wherein the paths intersect.

55. The method of claim 47 with the step of establishing one or more positions having an associated game.

56. The method of claim 47 with the step of allowing the player to acquire items.

57. The method of claim 47 with the step of allowing the player to acquire privileges.

58. The method of claim 33 wherein the awarding the player values step includes the step of selecting one of the following values: money, credits, privileges, items, another game, other events, other paths.

59. A casino game of chance for at least one player comprising:

- a) a game surface accessible and visible to the player in the casino;
- b) a plurality of paths on the game surface arranged for player selection of one path, each path having at least two positions beginning at start position, and finishing at end position;
- c) at least one position having an outcome;
- d) movable indicia on the game surface, the movable indicia for showing the position on a selected path of the player;
- e) a mechanism of chance carried on the game surface and available to the player in the casino, the mechanism of chance for determining movement along the player selected path and awarding the player values associated as the outcome with positions along the selected path, and
- f) structure in the casino game of chance to relate a random frequency of a bonus game to the probability of landing on each position and to a value of each position so that an expected value of each of the paths is approximately identical for a house advantage is in a predetermined range.

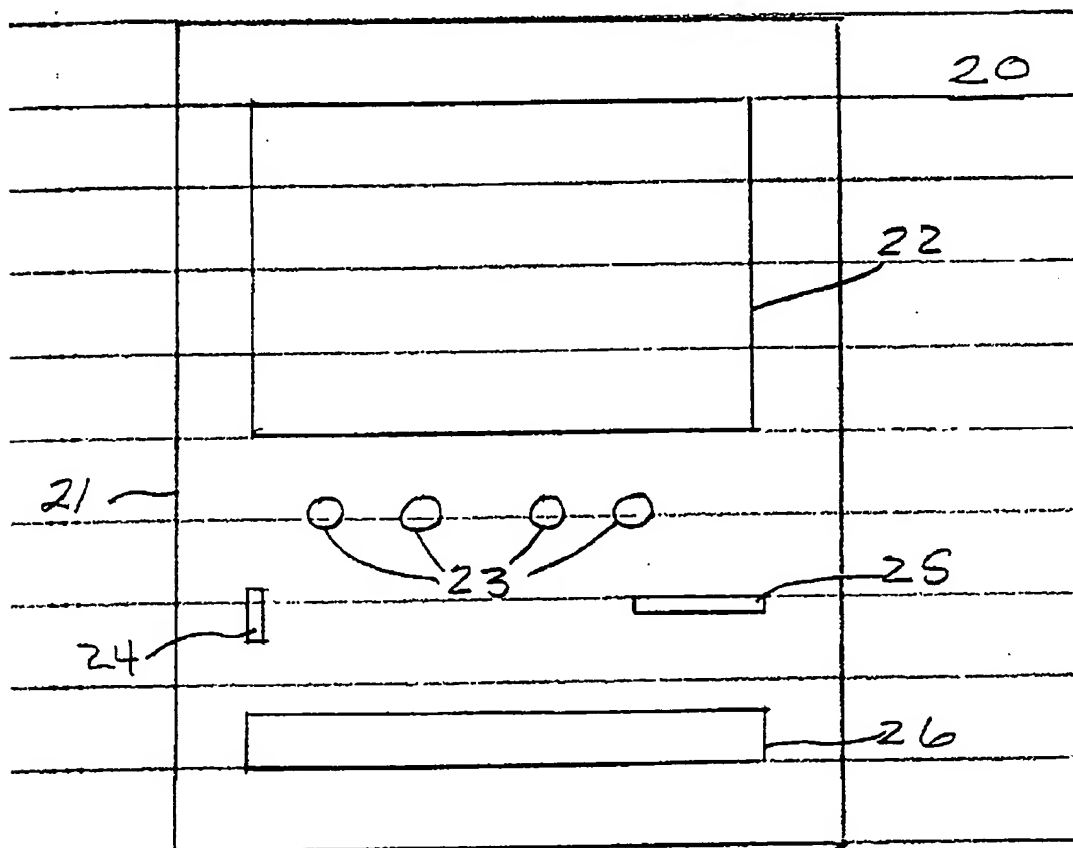
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US 20030176212A1

(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2003/0176212 A1****Schlottmann et al.**(43) **Pub. Date:****Sep. 18, 2003**(54) **MODELED GAMES AND PAY TABLE  
GENERATION AND EVALUTION  
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**Chicago, IL 60603-5803 (US)**(21) **Appl. No.:** 10/078,295(22) **Filed:** Feb. 18, 2002**Publication Classification**(51) **Int. Cl.<sup>7</sup>** ..... **A63F 13/00**(52) **U.S. Cl.** ..... **463/20; 273/138.3**(57) **ABSTRACT**

A video gaming machine simulates a real physical game, such as pachinko, by providing a mathematical model of the game including rules governing movement of an object placed in motion in accordance with a set of initial conditions. A pay table for the game is developed by creating a list of outcomes, assigning a probability of occurrence to each outcome, assigning a win amount to each outcome, and determining a pay table percentage by multiplying each outcome's probability of occurrence by its win amount and summing the products for all of the outcomes in the list. Creation of the list of outcomes and assignment of probabilities of occurrence may be effected by a Monte Carlo test. The game is played by randomly selecting a set of initial conditions and running them through the model. Alternatively, each route that the object may take can be broken down into a plurality of route segments or paths, each play of the game consisting of a chain of several paths respectively initiated by changes in direction of the object, such as by obstructions in the play field. Another option is to run the model backward from a desired outcome to a starting condition and then run the model forward from the starting condition.



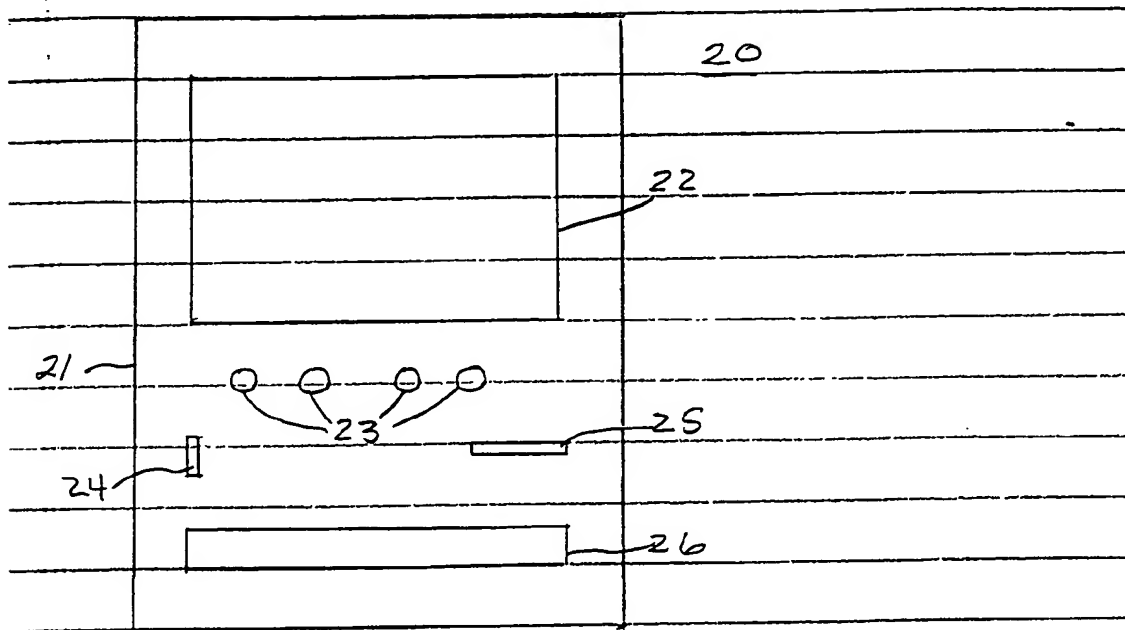


FIG. 1

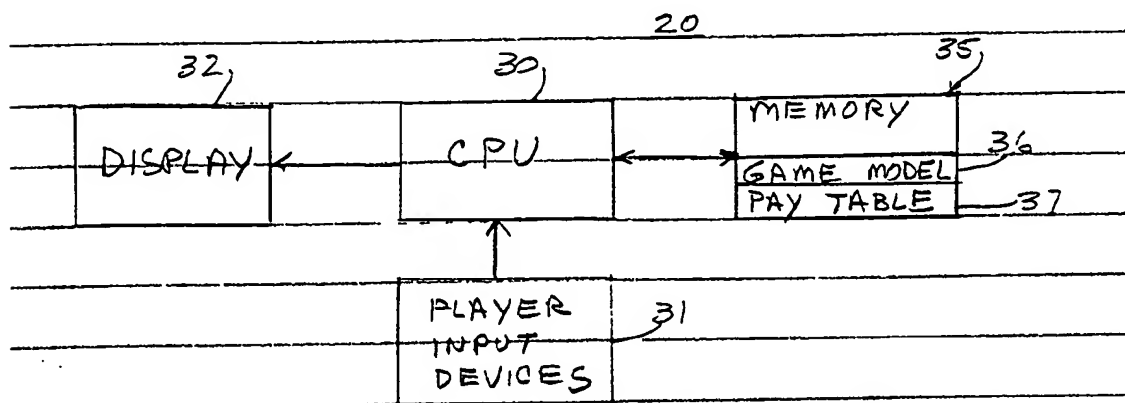
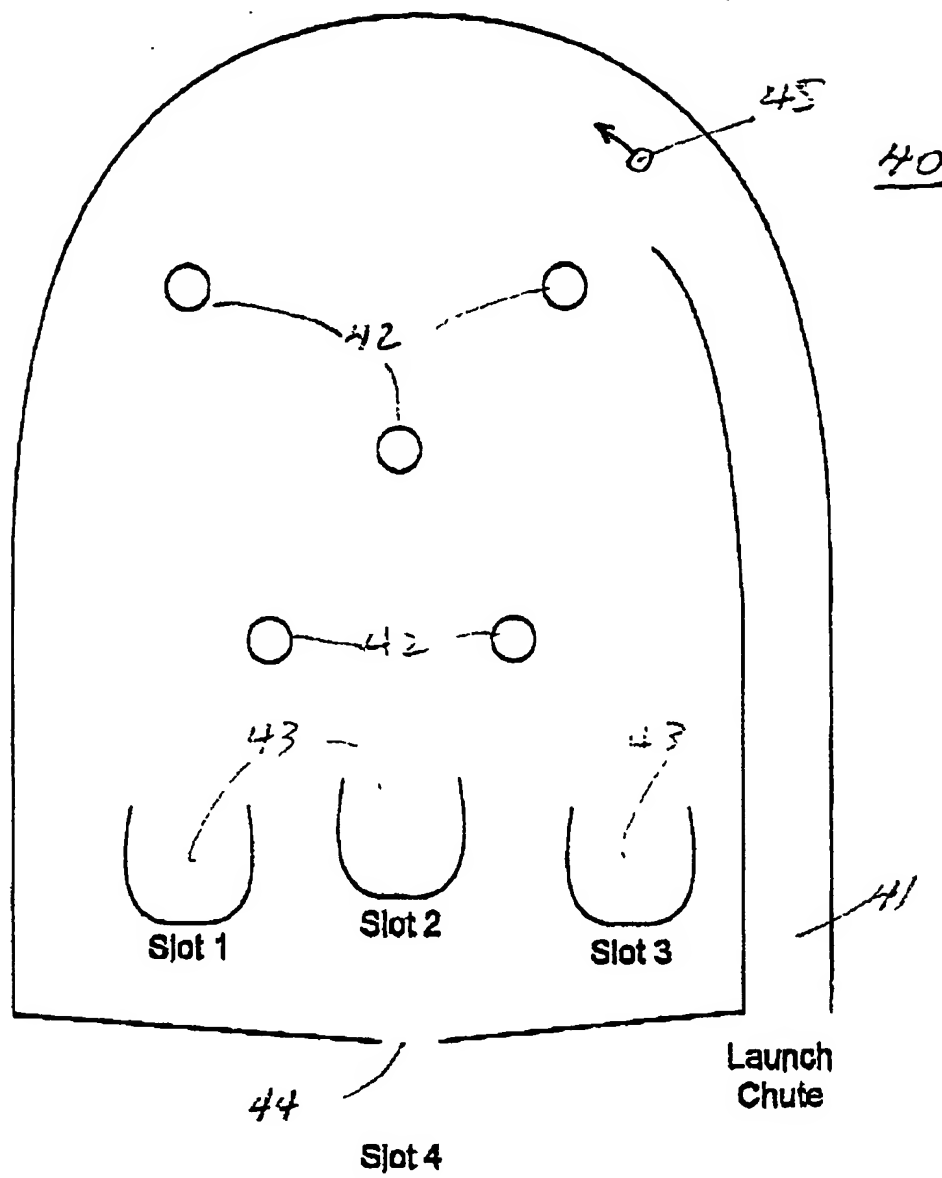


FIG. 2



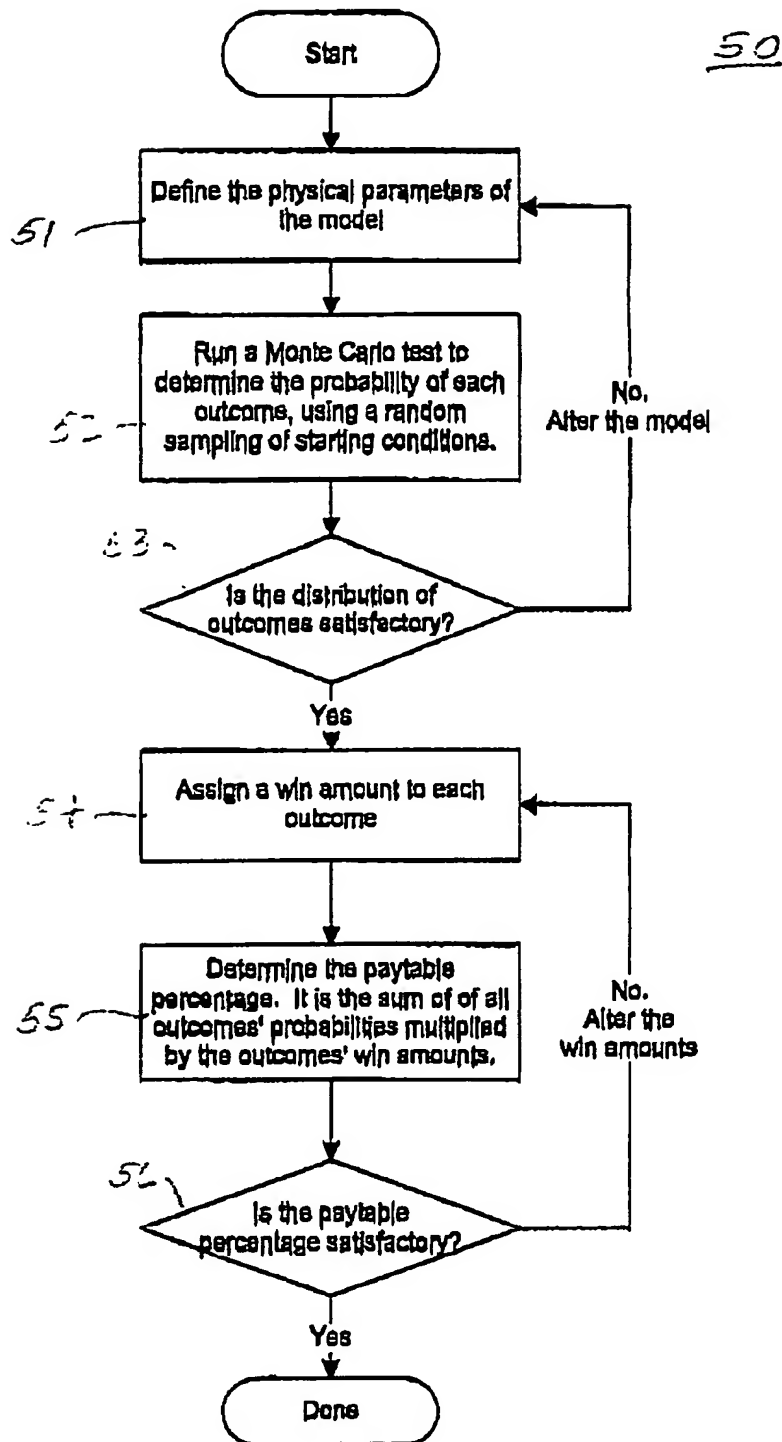


FIG. 4

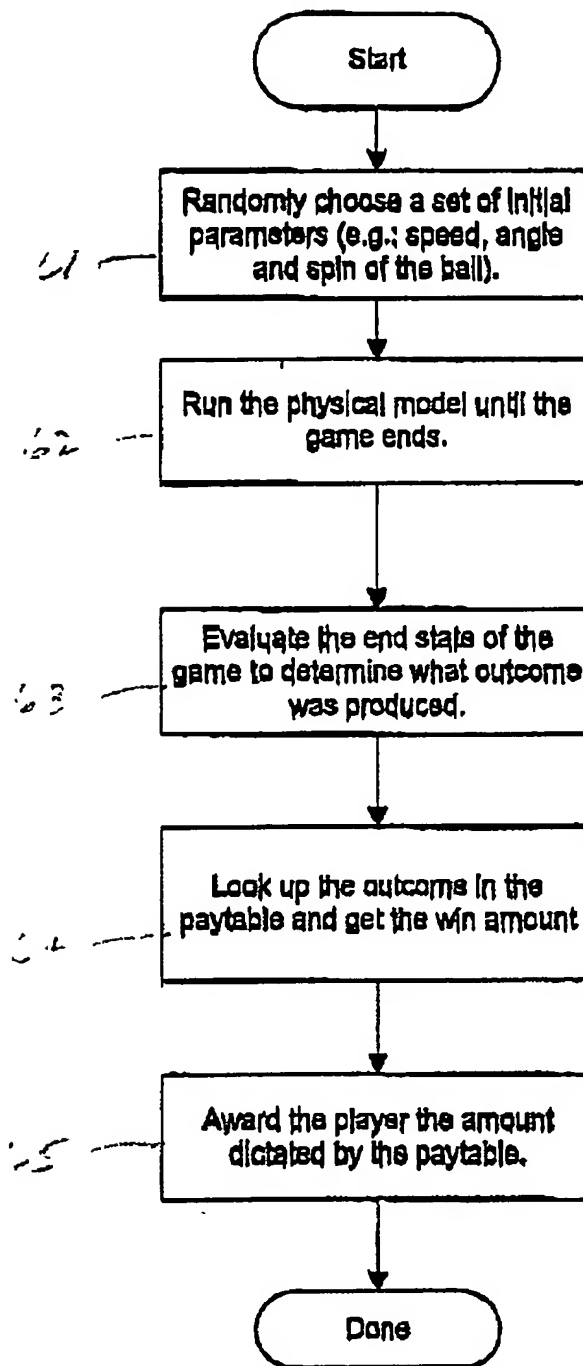


FIG. 5

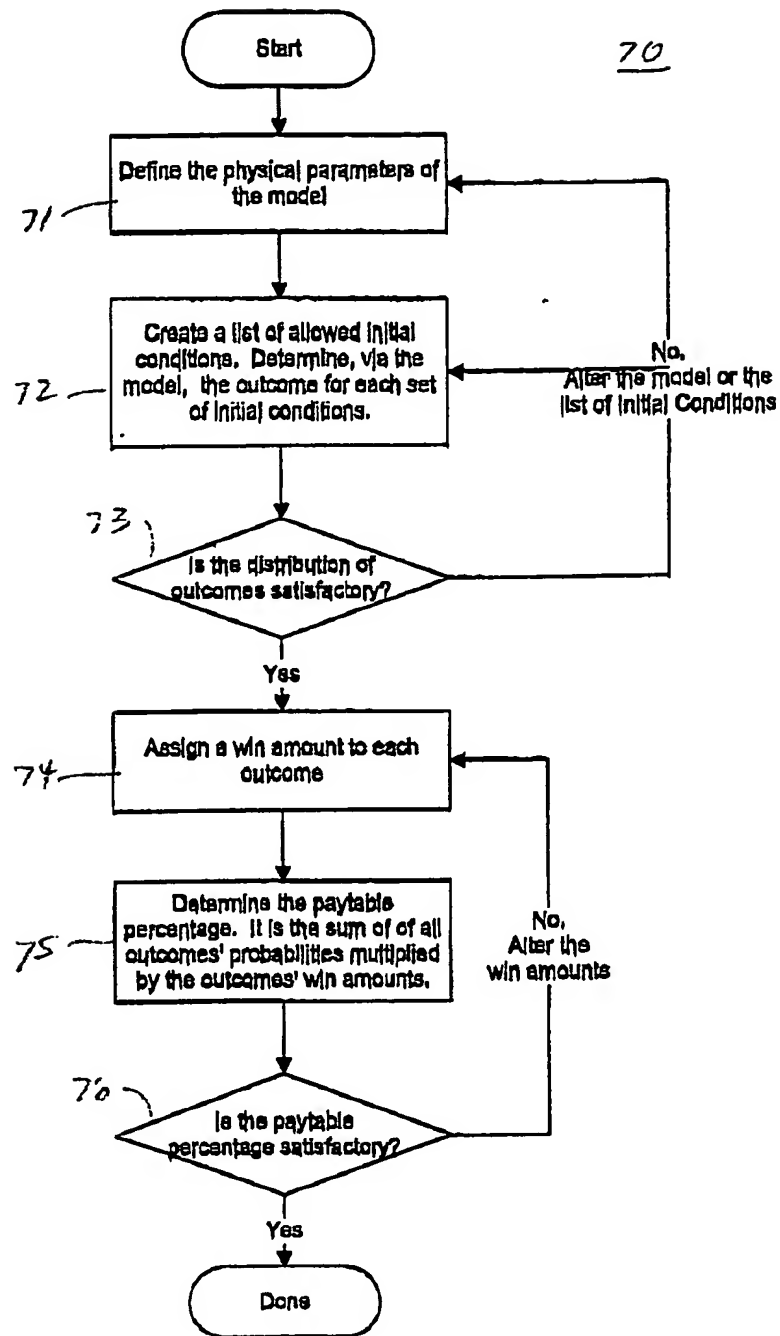


FIG. 6

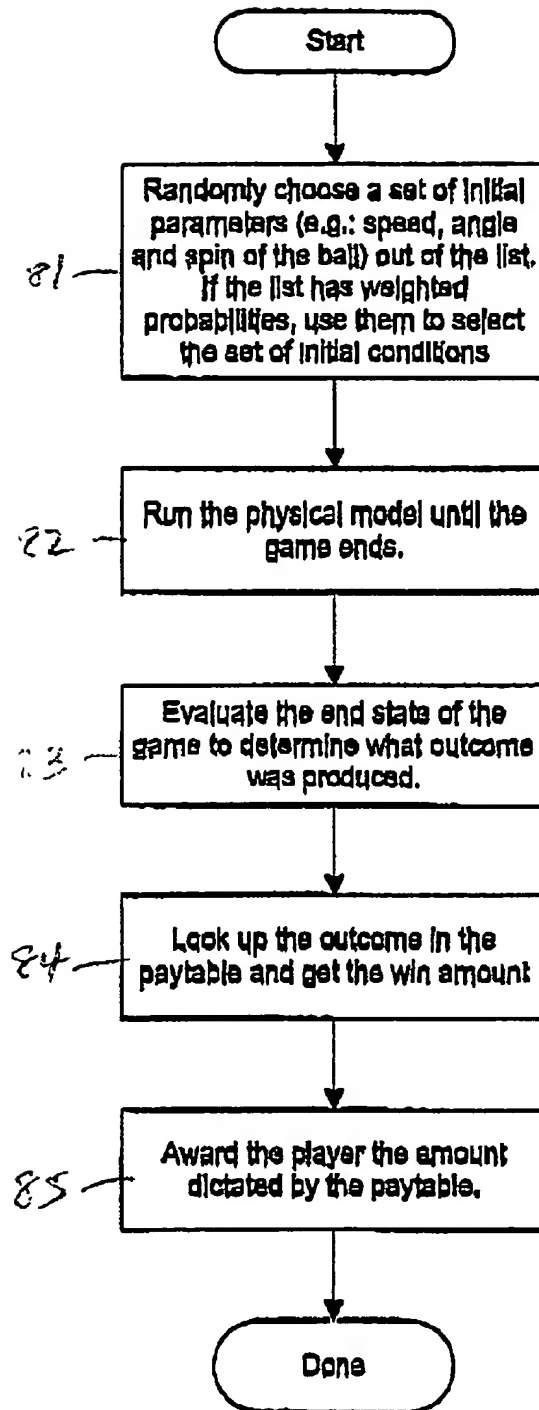
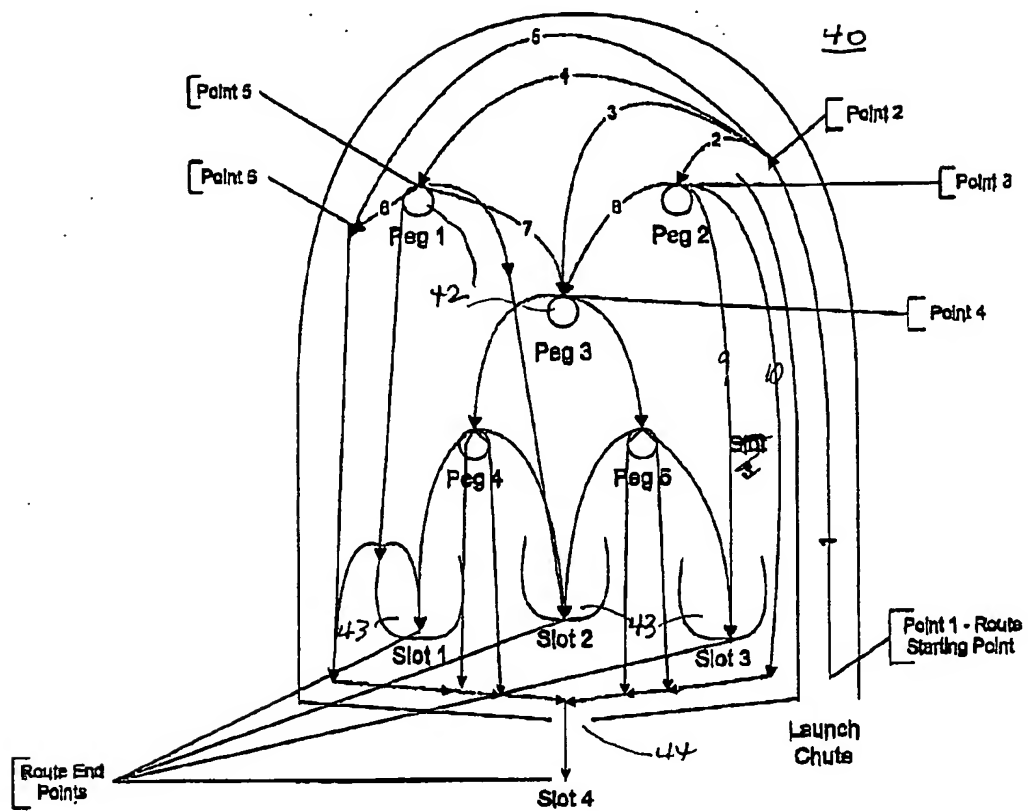


FIG. 7



F16.8

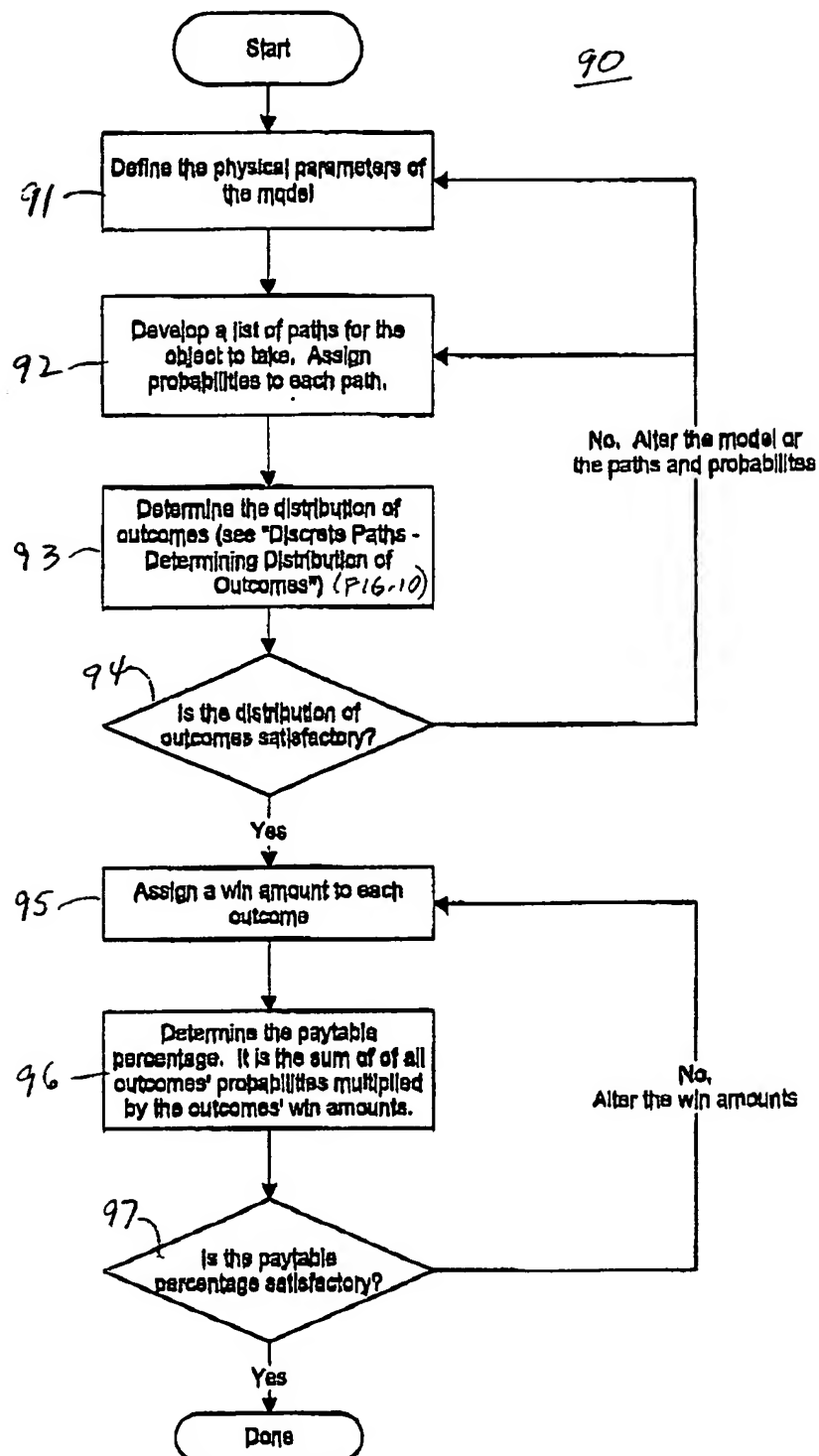
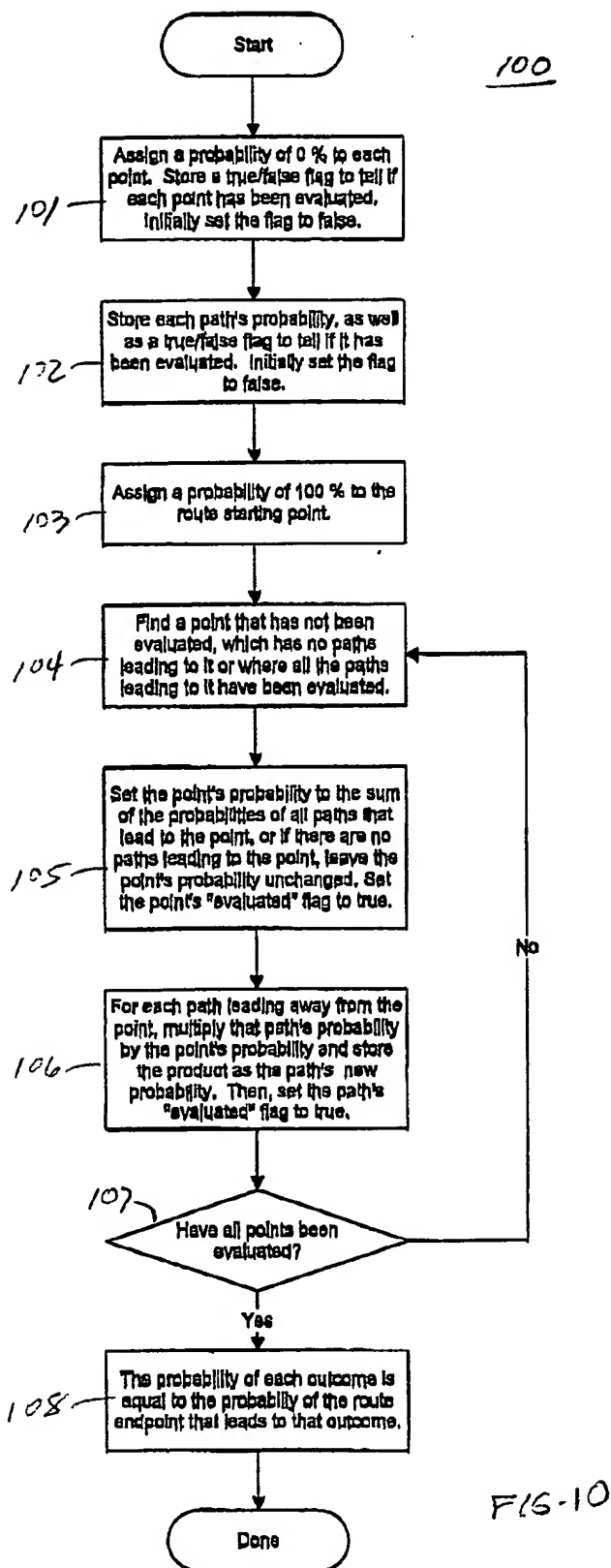


FIG. 9



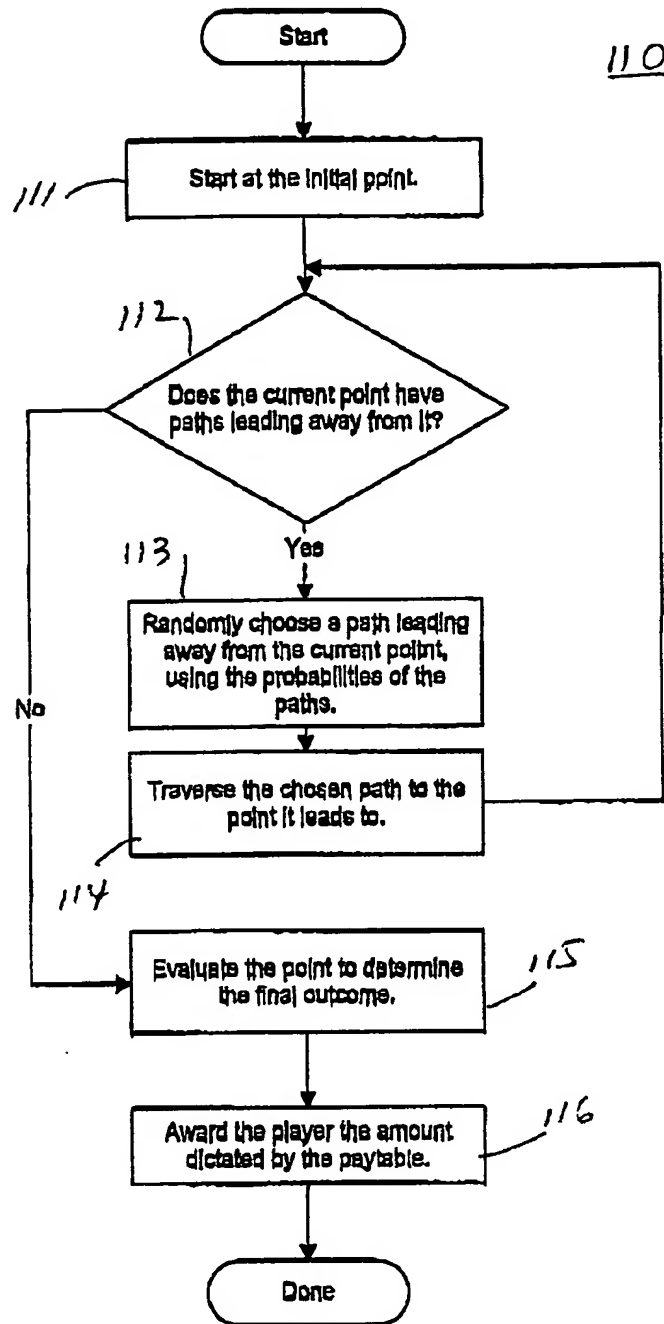


FIG. 11

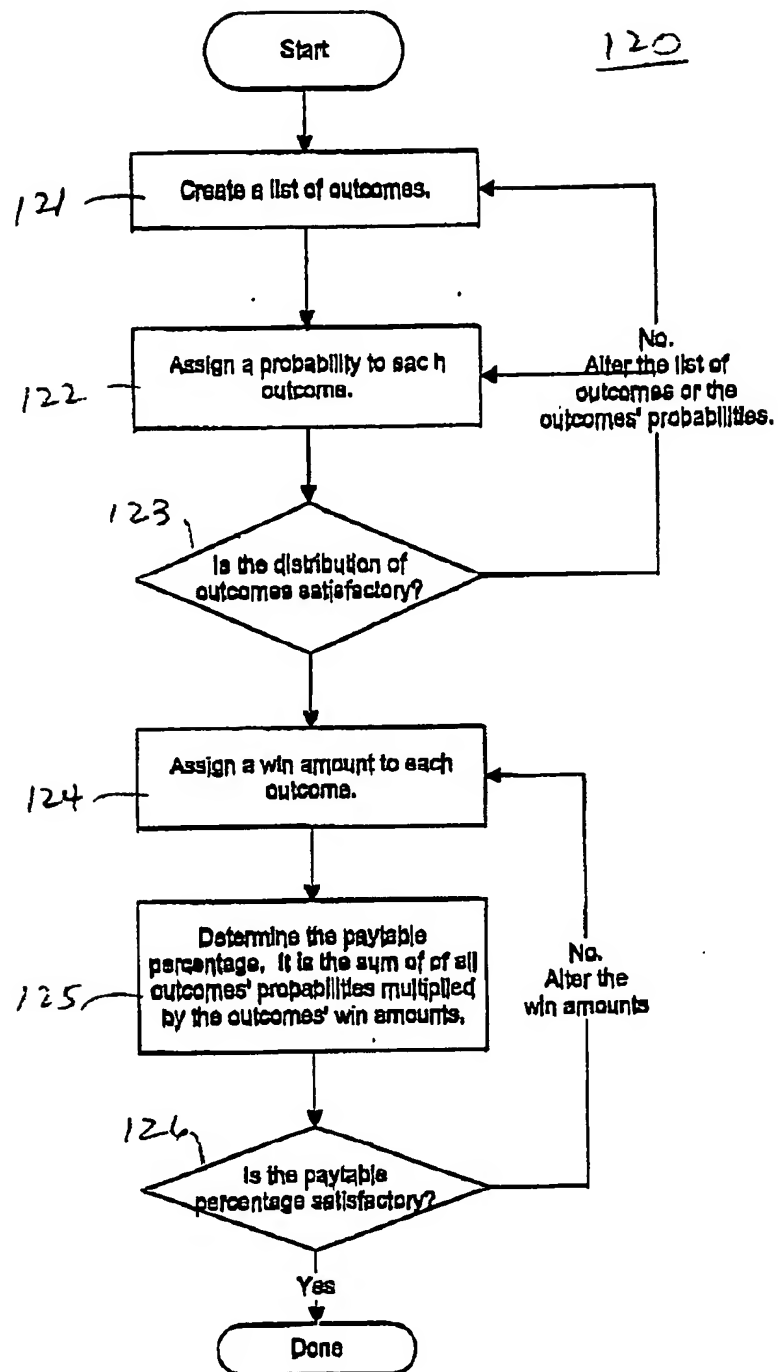


FIG. 12

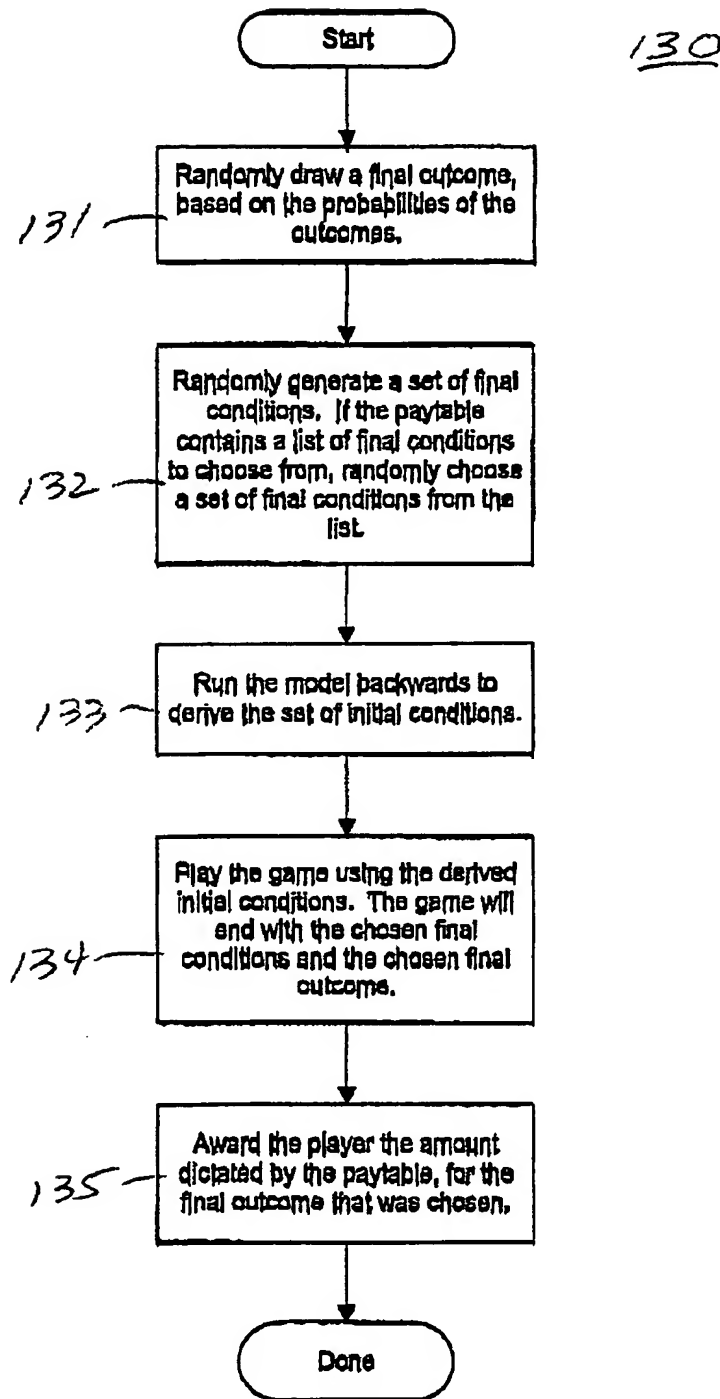


FIG. 13

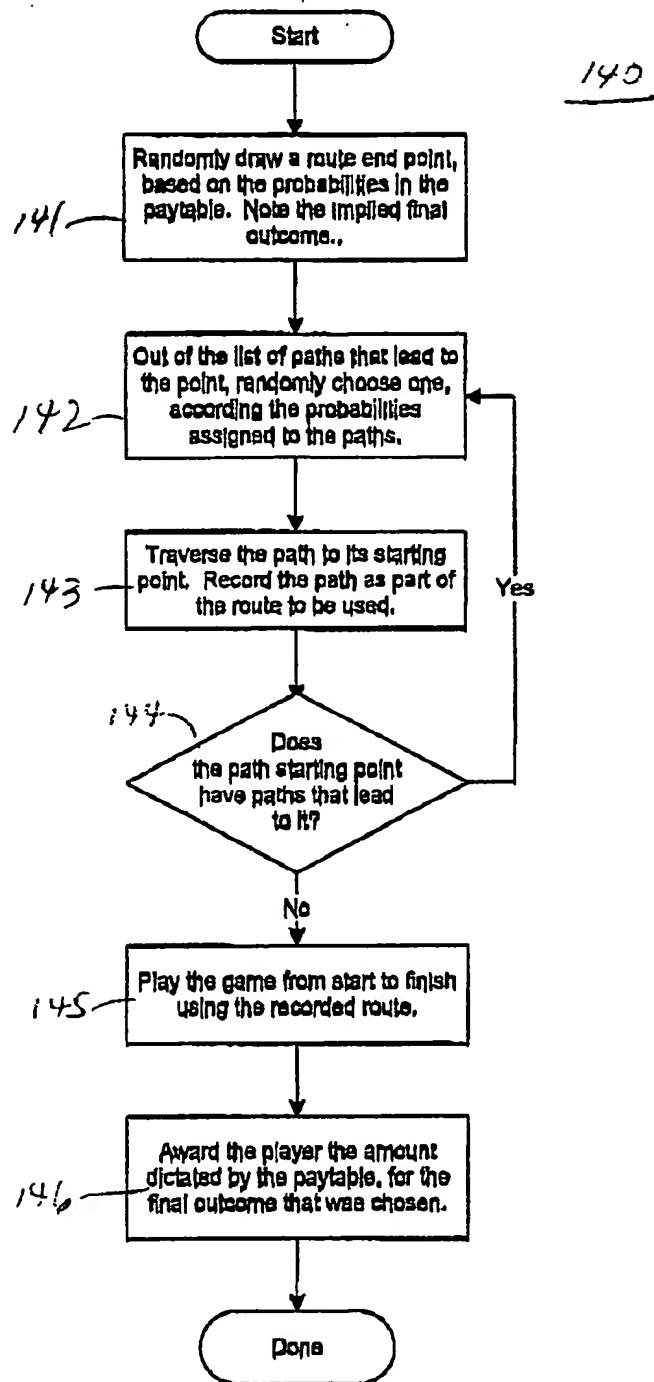


FIG. 14

## MODELED GAMES AND PAY TABLE GENERATION AND EVALUTION THEREFOR

### BACKGROUND

[0001] This application relates to gaming machines and, in particular, to video gaming machines of the type which simulate real physical games. The application relates in particular to techniques for operating such video gaming machines and for developing pay tables therefor.

[0002] A number of physical games involve the movement of one or more objects on a play field. Such games may include pinball, pachinko, roulette, craps and the like. Each of these games is initiated by placing an object in motion in accordance with a set of initial conditions and proceeding to one of a plurality of outcomes corresponding, respectively, to final resting conditions of the object or objects.

[0003] In pachinko and pinball, the object is a ball which is launched onto a play field with a particular velocity in a particular direction and, perhaps, with a particular spin. These initial conditions determine the initial trajectory of the ball. The trajectory and velocity of the ball are changed en route by obstacles in the play field, such as pins or pegs or flippers or the like. Plural balls may simultaneously be traveling along the play field, particularly in pachinko. The fundamental difference between pachinko and pinball is that, in pachinko, the trajectory-changing obstacles in the play field are fixed and passive, whereas in pinball they may be movable and active and, indeed, may be player-controllable. In a game such as roulette, which is played with a single ball, the play field itself, which includes a rotatable roulette wheel, is movable relative to a fixed reference, in addition to the ball being movable relative to the play field, both the ball and the wheel being placed into motion by a croupier. In craps, the object is a cubical die with numbered faces, the game being initiated by a player manually casting a pair of dice onto the play field. In games such as pachinko and craps, wherein plural objects simultaneously occupy the play field, the routes of the objects are complicated by the fact that they can collide with each other. The details of play of these games will be well understood by those of ordinary skill in the gaming arts. In such real physical games, there is no need for a pay table to determine the outcome or the win amount. Rather, they rely on actual physical resting conditions of the objects. However, in an electronic version of such games on a video platform, a method of producing and reliably evaluating a pay table is required.

[0004] Prior video gaming machines which simulate such real physical games as those described above have provided a storage medium which stores a plurality of "plays" of the game, such as a plurality of different object routes from a starting condition to a final outcome. Win amounts are assigned to each of these stored "plays". A play is initiated by a player "depositing" a wager amount and activating the machine, which then randomly selects one of the stored object routes and displays it on a video display and then awards the player the corresponding win amount. The display may include a background display of the play field, as well as a superimposed display of the randomly selected object route. The object routes could be stored, for example, by videotaping actual plays of physical games and storing them in analog or digital form. A drawback of this approach is that the number of object routes which can be stored is

rather limited. Thus, during an extended player session at the machine, a particular route, and therefore, outcome, may occur more than once, seriously detracting from the randomness and, therefore, the realism of the game.

### SUMMARY

[0005] This application relates to video gaming machines and methods of operating such machines which avoid the disadvantages of prior video gaming techniques while affording additional structural and operating advantages.

[0006] An important aspect is the provision of a video gaming machine of the type which simulates a real physical game, and which more realistically simulates the randomness of the real physical game.

[0007] Another aspect is the provision of a video gaming machine which is based on a mathematical model of a real physical game.

[0008] Another aspect is the provision of a method for accurately developing a pay table for a modeled game on a video gaming platform.

[0009] Certain ones of these and other aspects may be obtained by providing a method of operating a video gaming machine which simulates a real physical game initiated by placing an object in motion in accordance with a set of initial conditions and proceeding to one of a plurality of outcomes corresponding respectively to final resting conditions of the object, the method comprising: establishing in software a mathematical model of the game including a plurality of rules governing movement of the object once it is placed in motion, establishing a range of possible values for each of a plurality of parameters, randomly selecting for each parameter a value from its associated range of values to establish the set of initial conditions, running the set of initial conditions through the model for simulating movement of the object to a final resting condition to determine the outcome, and displaying the simulated movement of the object.

[0010] Further aspects may be attained by providing a method of operating a video gaming machine which simulates a real physical game initiated by placing an object in motion in accordance with a set of initial conditions and proceeding along a route to one of a plurality of outcomes corresponding respectively to final resting conditions of the object, the method comprising: determining a finite collection of points on a play field including a route starting point and at least one route end point corresponding to a final resting condition and a finite collection of possible paths of the object from one point to another such that each point except route end points may have one or more paths leading away from it, assigning a probability of occurrence to each path and to each point, randomly selecting a path from among the paths leading away from the route starting point in accordance with their probabilities of occurrence, causing the object to traverse the selected path to the point it leads to, then randomly selecting a path from among the paths starting at the point at which the object is currently located in accordance with their probabilities of occurrence, then repeating the preceding two steps until a route end point is reached, and displaying the simulated movement of the object from route starting point to the route end point.

[0011] Still other aspects may be attained by providing a video gaming machine which simulates a real physical game

initiated by placing an object in motion in accordance with a set of initial conditions and proceeding to one of a plurality of outcomes corresponding respectively to final resting conditions of the object, the gaming machine comprising: a player input device for activating the game, a display device, a processor operating under control of a stored program and responsive to the input device for controlling the display device, a memory device coupled to the processor and storing a mathematical model of the game including a plurality of rules governing movement of the object once it is placed in motion, and a pay table of win amounts respectively corresponding to different outcomes, and a payout mechanism, the processor program including a first routine responsive to a player input for randomly determining an origin state and running it through the model for simulating movement of the object to a final resting condition to determine an outcome and controlling the display device to display the simulated movement of the object, and a second routine for determining from the pay table a win amount corresponding to the outcome and actuating the payout mechanism to award that amount to the player.

[0012] Still other aspects may be attained by providing a method of developing a pay table for a video gaming machine which simulates a real physical game initiated by placing an object in motion in accordance with a set of initial conditions and proceeding to one of a plurality of outcomes corresponding respectively to final resting conditions of the object, the method comprising: establishing in software a mathematical model of the game including a plurality of rules governing movement of the object once it is placed in motion, creating a list of outcomes, assigning a probability of occurrence to each outcome, assigning a win amount to each outcome, and determining a pay table percentage by multiplying each outcome's probability of occurrence by its win amount and summing the products for all of the outcomes in the list.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0013] For the purpose of facilitating an understanding of the subject matter sought to be protected, there are illustrated in the accompanying drawings embodiments thereof, from an inspection of which, when considered in connection with the following description, the subject matter sought to be protected, its construction and operation, and many of its advantages should be readily understood and appreciated.

[0014] FIG. 1 is a simplified front elevational view of a video gaming machine;

[0015] FIG. 2 is a functional block diagrammatic illustration of the video gaming machine of FIG. 1;

[0016] FIG. 3 is a simplified diagrammatic illustration of a pachinko game play field;

[0017] FIG. 4 is a simplified flow chart of an embodiment of a pay table development program routine;

[0018] FIG. 5 is a simplified flow chart of a program routine for game play with a pay table developed in accordance with FIG. 4;

[0019] FIG. 6 is a simplified flow chart of a program routine for another embodiment of pay table development;

[0020] FIG. 7 is a simplified flow chart of game play using a pay table developed in accordance with FIG. 6;

[0021] FIG. 8 is a simplified diagrammatic illustration of a pachinko play field showing another embodiment of game play;

[0022] FIG. 9 is a simplified flow chart of a program routine for another embodiment of pay table development;

[0023] FIG. 10 is a simplified flow chart of a program routine for determining the distribution of outcomes in connection with the flow chart of FIG. 9;

[0024] FIG. 11 is a simplified flow chart of game play using a pay table developed in accordance with FIGS. 9 and 10;

[0025] FIG. 12 is a simplified flow chart of a program routine for another embodiment of pay table development;

[0026] FIG. 13 is a simplified flow chart of a game play using a pay table developed in accordance with FIG. 12; and

[0027] FIG. 14 is a simplified flow chart of another embodiment of game play utilizing a pay table developed in accordance with a combination of FIGS. 9, 10 and 13.

#### DETAILED DESCRIPTION

[0028] Referring to FIGS. 1 and 2, there is illustrated a video gaming machine, generally designated by the numeral 20. The gaming machine 20 has a housing 21 containing a video display 22 and a number of player control buttons or other types of actuators 23. Typically, the gaming machine 20 will also include a wager-receiving apparatus, which may include a coin or token slot 24 and a bill or card slot 25. Typically, the gaming machine 20 will also be provided with a payout tray 26 and/or a slot for dispensing tickets or the like. Referring to FIG. 2, the gaming machine 20 includes a central processing unit ("CPU") 30, to which it is connected player input devices 31, which may include the buttons 23 and the slots 24 and 25 and associated mechanisms. The CPU 30 is also connected to a display circuit 32, which includes the video display screen 22, and to a memory 35, in which is stored a mathematical model 36 of the game and a pay table 37, as will be explained more fully below. The gaming machine 20 is illustrated in very simplified form, since further details are well understood by those skilled in the art and are unnecessary for an understanding of the concepts of this application. It will be appreciated that many variations of the gaming machine 20 are available.

[0029] The concepts and principles of the present invention will be described in the context of a pachinko game, a simplified play field for which is illustrated in FIG. 3, but it will be appreciated that the principles of the invention are applicable to other types of games in which an object is placed in motion in accordance with a set of initial conditions and proceeds to one of a plurality of outcomes corresponding to final resting conditions of the object. Other examples of such games are described above. Referring to FIG. 3, the pachinko game will have a play field 40, which will be displayed on the video display screen 22 of the gaming machine 20. The play field includes a ball launch chute 41, a plurality of obstacles on the play field, which may be in the nature of pins or pegs 42, and a plurality of final destinations for the balls, which may include a plurality of pay slots 43, respectively designated "Slot 1", "Slot 2", and "Slot 3", as well as a non-pay slot 44 designated "Slot 4." While only a few of the pegs 42 and slots 43 and 44 are

illustrated for simplicity, in a real pachinko game, and in a video representation thereof, there typically would be many more of these items, as well as various other display features.

[0030] In the play of an actual physical pachinko game, a ball 45 is launched from the bottom of the launch chute 41, exits the launch chute in the direction generally indicated by the arrow in FIG. 3 and will eventually fall by gravity toward the bottom of the play field, colliding with one or more pegs 42 or with the side walls of the play field along the way, and eventually falling into one of the slots 43 or 44. If a ball falls into one of the pay slots 43, the player will be awarded a certain win amount, which is generally a function of the likelihood of the ball falling into that slot. The highest likelihood, however, is that the ball will fall into the slot 44 which, accordingly, is a losing slot for which the win amount is zero. The game is typically played with a large number of balls which may be launched in rapid succession so that multiple balls are traversing the play field 40 at the same time. In this case, the balls can collide with one another, altering their routes along the play field. It will be appreciated that, in a real physical pachinko game, the routes of the balls can be controlled somewhat by the player who manually operates a launch mechanism, so that he can vary the force with which the ball is launched, the rapidity with which successive balls are launched, and, to a slight extent, the initial spin and direction of the ball. However, it will be appreciated that in a video version of the game, the initial conditions of each ball launch will be automatically governed by the gaming machine and, for any given ball launch, the only control the player has is to initiate the launch sequence and, therefore, control the time at which the launch occurs. In the video version of the game, an iconic representation of the ball is displayed and the game will simulate the physical movement of the ball along the play field and will display that simulated movement.

[0031] A significant aspect of the invention is that the actual play of the video game is based, not on a stored collection of ball routes, but rather on a mathematical model of the game stored in memory, which model includes a number of rules which govern the physical movement of the ball, using known mathematical modeling techniques, to which are applied a set of initial conditions under which the ball is placed in motion. In an actual physical game, it will be appreciated that this movement is affected by not only by the initial conditions or parameters under which the ball is launched, but also by the physical characteristics of the ball itself, the inclination of the play field, the physical characteristics of the play field, such as friction and the like, the arrangement of the play field boundary walls and obstacles and the like. Each time a ball collides with an obstacle, such as a wall of the play field, a peg 42, another ball or the like, the way in which its route will be altered will be a function of physical characteristics of the obstacle, such as shape, size resiliency, etc., and the trajectory, velocity and spin etc. of the ball at the time of collision. It can be seen that, in the physical game, these factors which affect ball movement are extremely complex and would be virtually impossible to completely accurately reproduce in a mathematical model. Thus, the model is necessarily somewhat simplified, but will, to the extent possible, represent realistic game conditions.

[0032] Also, as was indicated above, in the video version of the game, it will be necessary to provide a pay table to establish the win amounts corresponding to each of the possible outcomes of a given ball launch. In order to understand the techniques described below, the following terms and definitions are provided:

[0033] "Pay table development"—filling out all the data required for a complete pay table. Different styles of pay tables will require different data. One pay table may require only a list of types of wins and the amounts paid. Other pay tables may require probabilities of those wins.

[0034] "Pay table evaluation"—determining the payout percentage for the pay table.

[0035] "Payout percentage"—the average percentage of money taken in that is returned to the player. For a 90% game, on the average, a player can expect to win back 90% of the money he wagers.

[0036] "Game play"—applying the rules of the game model and the pay table to play a game and produce an outcome. The outcome is evaluated to determine the payout, as dictated by the pay table. That amount is then awarded to the player.

[0037] This application describes four basic techniques of developing a pay table and using it in the play of a game, although some of the steps of these techniques may be interchangeable, resulting in hybrid techniques.

#### [0038] Technique 1—Full Model Behavior

[0039] In this technique, the game model follows, as closely as possible, the behavior of a physical game. Since the model is deterministic, the outcome of the game is dependent only on the initial parameters of the game, i.e., the initial conditions of each ball launch, such as the speed, angle and spin of the ball. The following descriptions will be based on the assumption that these are the only relevant initial conditions, but it will be appreciated that other parameters could be added without affecting the technique.

[0040] In developing a pay table, there will likely be too many possible sets of initial parameters or conditions to test each set individually. For example, if each of the parameters speed, angle and spin may range from zero to 65,535, there are 281,474,976,710,656 possible sets of these three initial conditions and, therefore, possible ball routes or game plays. Accordingly, pay table development must be done using a Monte Carlo approach. In this approach, the game model randomly runs a large sample of games by randomly selecting a large number of sets of initial conditions (millions or more) and running them through the model, recording the outcome for each one. For example, the value of each parameter speed, angle and spin is randomly selected from its range (e.g. 0-65,535) of possible values to arrive at a set of initial conditions, which is then run through the model, and the process is reported. It will be appreciated that the number of possible outcomes is limited by the number of destination slots on the play field, i.e., in the example illustrated in FIG. 3, there are four possible outcomes for each ball route. After recording all of the outcomes, the program determines how frequently each outcome occurred and, thus, the probability of occurrence of each outcome, resulting, e.g., in data as set forth in Table 1.

TABLE 1

Outcome	Probability
Slot 1	35%
Slot 2	9%
Slot 3	1%
Slot 4	55%
Total	100%

[0041] The pay table developer then assigns a win amount to each outcome, based upon its probability of occurrence, resulting, e.g., in a pay table such as Table 2.

TABLE 2

Outcome	Probability	Win Amount
Slot 1	35%	1
Slot 2	9%	5
Slot 3	1%	15
Slot 4	55%	0
Total	100%	

[0042] In order to evaluate the pay table, each win amount's contribution to the pay table percentage is computed as that win amount multiplied by the probability of occurrence of the corresponding outcome. The sum of all these win amount contributions is the pay table percentage. In this example, illustrated in Table 3, the pay table percentage is 95%.

TABLE 3

Outcome	Probability	Win Amount	Contribution to payable percentage
Slot 1	35%	1	35%
Slot 2	9%	5	45%
Slot 3	1%	15	15%
Slot 4	55%	0	0%
Total	100%		95%

[0043] The probability of occurrence information is inherent in the model and, therefore, need not be stored in the final pay table, which requires only the data set forth in Table 4.

TABLE 4

Outcome	Win Amount
Slot 1	1
Slot 2	5
Slot 3	15
Slot 4	0

[0044] This technique of pay table development may be summarized with reference to the program routine flow chart 50 illustrated in FIG. 4. At 51, the developer defines the physical parameters of the model and then, at 52, runs a Monte Carlo test to determine the probability of occurrence of each of the possible outcomes, using a random sampling of sets of starting conditions. The routine then checks at 53 to see if the distribution of outcomes is satisfactory, i.e.,

either provides a realistic simulation of actual physical game conditions or provides a distribution which will be conducive to generating player interest and excitement. If not, the developer may alter the physical model. Otherwise, the routine proceeds to 54, to assign a win amount to each outcome, based upon its probability of occurrence and then, at 55, determines the pay table percentage. The routine then checks at 56 to see if the pay table percentage is satisfactory e.g., to meet the requirements of maintaining player interest, while at the same time providing satisfactory return to the gaming establishment in which the video game is located. If not, the win amounts may be altered accordingly at 54. Otherwise, the routine is completed.

[0045] In order to play the game, the player would first activate the game by placing a wager, such as by inserting coins or bills into the appropriate slot 24 or 25. This would typically result in the gaming machine 20 displaying on the display 22 a representation of the game play field and, possibly other indicia. A particular wager amount may entitle a player to a certain number of balls. Individual ball launches could be triggered by the player actuating one of the buttons or other control devices 23. Referring to the flow chart 60 in FIG. 5, when a ball launch signal is input by the player, the program routine, at 61, randomly chooses a set of initial parameters or conditions for the ball. This may be done by randomly selecting each parameter individually as described above. Then, at 62, the routine plays the game by running the selected set of initial conditions through the model until an outcome is reached. Then, at 63, the routine evaluates the final resting position of the ball, i.e., which slot it wound up in, to determine what outcome was produced and then, at 64, looks up the outcome in the pay table of Table 4 to determine the win amount. Then, at 65, that amount is awarded to the player. This is repeated for each ball launch, and win amounts awarded for the several balls are accumulated until the supply of balls is exhausted.

[0046] It will be appreciated that with this technique, the outcome of each play is completely unpredictable, i.e., the outcome is unknown until it is reached.

[0047] Technique 2—Limited Initial Conditions

[0048] This technique is a modification of technique 1, described above. In technique 1, while millions of games are played in the Monte Carlo test, the only thing that is recorded is the outcomes in order to determine their probability of occurrence. In the limited initial condition technique, the model again compiles a list of thousands or millions of entries by randomly selecting sets of initial conditions and running them through the model to determine the outcomes, but in this case both the initial conditions and the outcome are recorded, as illustrated in Table 5.

TABLE 5

Speed	Angle	Spin	Outcome
3245	9558	53835	Slot 4
3634	46742	65452	Slot 4
12	325	0	Slot 1
32432	54353	32212	Slot 2
23423	35345	21223	Slot 2
5412	2357	22349	Slot 3
... The list may contain thousands or millions of entries ...			

[0049] The flow chart 70 for this technique is set forth in FIG. 6. As can be seen, the routine first, at 71, defines the physical parameters of the model and, at 72, creates the list of allowed initial conditions and determines their outcomes by running them through the model. The probability of occurrence of each outcome is then determined and listed, as described above, resulting in Table 6.

TABLE 6

Outcome	Probability
Slot 1	35%
Slot 2	5%
Slot 3	1%
Slot 4	59%
Total	100%

[0050] Then, at 73, the routine checks to see if the distribution of outcomes is satisfactory. If not, the routine can either alter the mathematical model at 71 or alter the list of initial conditions at 72 by, for example, removing entries for outcomes that are desired to be made more rare, or adding entries for outcomes that are desired to be made more common. Alternatively, each set of initial conditions could be assigned an arbitrary probability of occurrence, which would then be applied when the game randomly draws a set of initial conditions during play of the game, as explained more fully below. However, it is preferred to add or subtract sets of initial conditions which will produce the desired outcome, since this produces a greater variety of games and preserves the random look of the full model behavior technique described above.

[0051] Then, at 74, the routine assigns a win amount to each outcome and then, at 75, determines the pay table percentage in the same manner described above, and then checks at 76 to see if the pay table percentage is satisfactory. If not, the win amounts may be altered at 74, otherwise, the pay table is completed.

[0052] The probability information is inherent in the list of sets of initial conditions and, therefore, need not be stored in the final pay table. The final pay table only requires the list of initial conditions i.e., Table 5 minus the outcomes, which are implied by the model and the list of outcomes and win amounts, as in Table 7.

TABLE 7

Outcome	Win Amount
Slot 1	1
Slot 2	8
Slot 3	20
Slot 4	0

[0053] Note that it would also be possible to add the win amounts to the list of sets of initial conditions, so that the outcomes and win amounts would be determined immediately upon random selection of a set of initial conditions, rather than waiting for the set of initial conditions to be run through the model to determine the outcome. However, that would consume much more space in memory, since the list of sets of initial conditions contains thousands or millions of entries or sets, whereas Table 7 has only four entries.

[0054] Referring to FIG. 7, there is illustrated a flow chart 80 of a routine for playing the game in accordance with this limited initial conditions technique of pay table determination. At 81, the routine randomly chooses a set of initial conditions from the list of sets. If the list has weighted probabilities associated with the sets, those probabilities are used in the random selection process. Then, the selected set of initial conditions is run through the physical model at 82 to a final resting condition or end point. Then, at 83, the routine evaluates the final condition to determine what outcome was produced and then, at 84, looks up the outcome in the pay table to determine the win amount and then, at 85, awards that win amount to the player.

[0055] Accordingly, it can be seen that in this method, only the sets of initial conditions listed in the pay table are possible of selection, whereas in the full model behavior method described above, any of possibly trillions of initial condition sets could be randomly selected. However, the number of sets of initial conditions in the list is sufficiently large that the distribution of outcomes will be substantially the same as for the full model behavior technique.

#### [0056] Technique 3—Discrete Paths

[0057] This technique starts with the full model of the real game, as outlined above, but breaks down the possible routes of the ball to a finite set of the most common route segments or paths. A number of such paths are illustrated in FIG. 8. More specifically, FIG. 8 designates paths by continuous lines terminating in arrowheads, a number of the paths being consecutively numbered. Each path has a beginning point and an ending point. Points that do not have any paths starting from them are designated as route end points. It can be seen that a ball route is made up of a series of connected paths, with all routes starting at point 1, which is the starting point for path 1, and ending with a path which terminates in one of the slots. It will be appreciated that FIG. 8 is greatly simplified, and that in reality there will be many more possible paths. However, FIG. 8 is sufficient to illustrate the principles involved. Thus, it can be seen that the play field is broken down into a number of paths and a number of points, such that at least one path starts from every point except a route end point, and at least one path terminates at every point except the route starting point (point 1).

[0058] Referring to FIG. 9, the flow chart 90 is a routine for developing a pay table in accordance with this technique. At 91, the routine first defines the physical parameters of the model as described above, and then, at 92, develops a list of paths for the object to take and assigns a probability of occurrence to each such path. This list may be developed by having the model sample millions of possible sets of initial conditions to produce the set of most common paths. Such a list of paths is set forth in Table 8, and includes the path number, the starting and ending points of the path, and all relevant data required to specify the path. This data may be a list of points through which the object travels along the path, or a starting point and starting conditions. The preferred technique is to store a set of starting conditions for each path, such that applying those starting conditions to the model causes the object (ball) to traverse the path to its ending point. For example, referring to FIG. 8 and Table 8, it can be seen that path 1 starts at point 1 and ends at point 2, whereas path 4 starts at point 2 and ends at point 5.

TABLE 8

Paths					
Path Number	Starting Point	Ending Point	Initial Speed	Initial Angle	Initial Spin
1	1	2	23443	34221	1210
2	2	3	65234	365	343
3	2	4	474	5335	4
4	2	5	32	4365	854
5	2	6	44574	366	5436
6	5	6	4432	37	9665
7	5	4	5474	343	964
8	3	4	2233	3234	7895

... Table shortened for simplicity ...

[0059] As can be seen from FIG. 8, each point, except a route end point (in one of the slots) has associated with it a list of paths which may originate from it. The probability of occurrence of each path represents the likelihood of the ball taking that path from the point. Points that do not have any paths starting from them are designated as route end points. Each route end point has an associated game outcome. Table 9 lists the first six points on FIG. 8, the paths that may start from each and the probability for each such path. Initially, these probabilities are assigned arbitrarily, except in the case of point 1, which has only one path leading from it, the probability of occurrence of which must, therefore, be 100%.

TABLE 9

Points		
Point number	Paths that may start from this point	Probability of each path
1	1	100%
2	2	30%
	3	20%
	4	40%
	5	10%
3	8	40%
	9	30%
	10	30%
4	11	50%
	12	50%
5	6	50%
	7	20%
	13	10%
	14	20%
6	15	100%

... Table shortened for simplicity ...

[0060] The routine then, at 93, determines the distribution of outcomes utilizing the subroutine 100 of FIG. 10. Referring to FIG. 10, the routine initially assigns a probability of 0% to each point, stores a true/false flag to tell whether or not the point has been evaluated, and initially sets the flag to "false." Then, at 102, the routine stores each path's probability, as well as a true/false flag to tell whether or not it has been evaluated, initially setting the flag to "false." Then, at 103, the routine assigns a probability of 100% to the route starting point (point 1). There results a points list (see Table 10) and a paths list (see Table 11). Tables 10 and 11 represent the conditions of the points and paths lists the first time through the subroutine 100.

TABLE 10

Paths			
Point number	Probability	Evaluated	Paths that may start from this point
1	100%	False	1
2	0%	False	3
	0%	False	3
	0%	False	4
	0%	False	5
3	0%	False	8
	0%	False	9
	0%	False	10
4	0%	False	11
	0%	False	12
5	0%	False	6
	0%	False	7
	0%	False	13
	0%	False	14
6	0%	False	15

... Table shortened for simplicity ...

[0061]

TABLE 11

Paths				
Path number	Starting Point	Ending Point	Probability	Evaluated
1	1	2	100%	False
2	2	3	30%	False
3	2	4	20%	False
4	2	5	40%	False
5	2	6	10%	False
6	5	6	50%	False
7	5	4	20%	False
8	3	4	40%	False

... Table shortened for simplicity ...

[0062] Then, at 104, the routine finds a point that has not been evaluated, which has no paths leading to it or where all the paths leading to it have been evaluated. The first time through this subroutine, the only point which meets these criteria will be point 1. Then, at 105, the subroutine sets the point's probability to the sum of the probabilities of all paths that lead to the point or, if there are no paths leading to the point (which is the case for point 1), leaves the point's probability unchanged, and then sets the point's evaluated flag to "true." Thus, at this point, Table 10 has been changed to list the evaluated flag for point 1 as "true," but is otherwise unchanged. Then, at 106, for each path leading away from the point, the routine multiplies that path's probability by the point's probability and stores the product as the path's new probability, then sets the path's evaluated flag to "true." In this case, point 1's probability is 100% and the only path leading from it is path 1, which also has a probability of 100%. Thus the new probability for path 1 remains 100%, so that the only change in Table 11 is to change the evaluated flag for path 1 to "true."

[0063] The routine then checks at 107 to see if all points have been evaluated. If not it returns to 104 and again looks for a point that has not been evaluated and where all the paths leading to it have been evaluated. The only point which meets these criteria now is point 2, which has not been evaluated but which has all paths leading to it (path 1)

evaluated. Since the probability of path 1 is 100%, the routine, at 105, sets point 2's probability to 100% and sets its evaluated flag to "true," changing Table 10 accordingly. Point 2 has four paths leading from it, viz, paths 2, 3, 4 and 5. Thus, at 106 of the routine, for each of those paths, its probability is multiplied by the probability of point 2 (100%) so that the initial probabilities of those paths remain unchanged, and then their evaluated flags are set to "true," changing Table 11 accordingly.

[0064] The next time through 104 of the routine, the only point which meets the criteria will be point 3, which has only one path (path 2) leading to it, which path has now been evaluated. Thus, at 105, the probability of point 3 is set to the probability of path 2 (30%) and its evaluated flag is set to "true," changing Table 10 accordingly, so that it now appears as in Table 12.

TABLE 12

<u>Points</u>				
Point number	Probability	Evaluated	Paths that may start from this point	
1	100%	True	1	
2	100%	True	2	
			3	
			4	
			5	
3	30%	True	8	
			9	
			10	
4	0%	False	11	
			12	
5	0%	False	6	
			7	
			13	
6	0%	False	14	
			15	

... Table shortened for simplicity ...

[0065] Point 3 has three paths leading away from it (paths 8, 9 and 10). Thus, at 106, those paths' probabilities are multiplied by the probability of point 3 and their paths' evaluated flags are set to "true", changing Table 10 accordingly, resulting in Table 13.

TABLE 13

<u>Paths</u>				
Path number	Starting Point	Ending Point	Probability	Evaluated
1	1	2	100%	True
2	2	3	30%	True
3	2	4	20%	True
4	2	5	40%	True
5	2	6	10%	True
6	5	6	50%	False
7	5	4	20%	False
8	3	4	12%	True

... Table shortened for simplicity ...

[0066] Thus, for example, the original probability of path 8 (40%) is multiplied by 30% to arrive at a new path 8 probability of 12% (paths 9 and 10 are omitted from the tables for brevity).

[0067] The subroutine 100 continues looping through 104-107 in this manner until all points have been evaluated.

Then, at 108, the probability of each outcome is determined as being the probability of the route end point that results in that outcome. Then, returning to FIG. 9, the routine 90 resumes at 94 to check to see if the distribution of outcomes is satisfactory. If not, the physical model may be altered at 91 and/or the list of paths may be altered at 92. Otherwise, the routine at 95, assigns a win amount to each outcome and then, at 96, determines the pay table percentage in the manner described above, and then checks at 97 to see if it is satisfactory. If not, the win amounts may be altered at 95, otherwise, the pay table development is completed, resulting in a pay table percentage as illustrated in Table 14.

TABLE 14

Outcome	Probability	Win Amount	Contribution to payable percentage
Slot 1	35%	1	35%
Slot 2	5%	8	40%
Slot 3	1%	20	20%
Slot 4	59%	0	0%
Total	100%		95%

[0068] Referring now to FIG. 11, there is illustrated a program routine 110 governing the play of the game in accordance with this technique. When a ball launch is initiated by the player, the routine, at 111, starts at the route starting point (point 1) and then, at 112, checks to see if the current point has any paths leading away from it. In this case it does (path 1). Then, at 113, the routine randomly chooses one of the paths leading away from the current point, using the probabilities of the paths. In this case, there is only one such path (path 1) so it is necessarily chosen. Then, at 114, the routine traverses that path to the point (point 2) that it leads to and returns to 112. This time through the loop, the current point (point 2) has four paths leading from it so, at 113, the routine randomly chooses one of them in accordance with their probabilities, traverses it at 114 and returns to 112. The routine continues in this manner until, at 112, the current point has no paths leading away from it, signifying that it is a route end point. The routine then moves to 115 to evaluate the point and determine the final outcome and, at 116, awards the player the win amount corresponding to that outcome from the pay table.

#### [0069] Technique 4—Reverse Play

[0070] In this method, the outcome is determined first, then the required initial conditions are generated to produce that outcome. The game is then played from those initial conditions. Referring to FIG. 12, there is illustrated a program routine 120 for pay table development using this technique. The routine first, at 121, creates a list of outcomes and then, at 122, assigns a probability of occurrence to each outcome. In the illustrated example, there are only four possible outcomes, and the assigned probabilities may be those set forth in Table 14. The routine then checks at 123 to see if the distribution of outcomes is satisfactory. If not, either the list could be altered at 121 to add or delete outcomes, or the probabilities could be altered at 122. If the outcomes' distribution is satisfactory at 123, the routine then, at 124, assigns a win amount to each outcome and then determines the pay table percentage at 125, resulting in a pay table such as that illustrated in Table 15.

TABLE 15

Outcome	Probability	Win Amount	Contribution to payable percentage
Slot 1	35%	1	35%
Slot 2	5%	8	40%
Slot 3	1%	20	20%
Slot 4	59%	0	0%
Total	100%		95%

[0071] At 126, the routine checks to see if the pay table percentage is satisfactory. If not, the win amounts may be altered at 124, otherwise pay table development is completed.

[0072] Referring to FIG. 13, there is illustrated a program routine 130 for a play of the game in accordance with this technique of pay table development. At 131, the routine randomly draws a final outcome from the list of outcomes, based upon the probabilities of the outcomes. Then, at 132, the routine randomly generates a set of final conditions, such as final velocity, angle, spin of the ball associated with the selected final outcome. Alternatively, the pay table may have associated with each outcome a list of final conditions to choose from. Then, at 133, a routine runs the model backwards from the outcome, using the selected set of final conditions, to derive a set of initial conditions which would lead to that outcome. Then, at 134, the routine runs the derived set of initial conditions through the model to play the game forward, whereupon the game will end with the originally selected outcome. The routine then at 135 awards the player the win amount dictated by the pay table for that outcome.

[0073] In this technique, because the final outcome is known from the start, very fast evaluation is provided.

[0074] Discrete Paths, Reverse Play

[0075] As was indicated above, it is possible to combine steps from different techniques to arrive at hybrid techniques. As an illustration, the reverse play technique 4 may be combined with the discrete paths technique 3. In this case, the pay table is generated in the same manner as for technique 3, described above, but the direction of the paths is reversed. Each route end point is assigned a probability of occurrence, wherein the probabilities of all of the route end points add up to 100%, resulting in Table 16.

TABLE 16

Outcome	Win Amount	Route End Points	Probability
Slot 1	1	13	35%
Slot 2	8	14	5%
Slot 3	20	15	1%
Slot 4	0	16	59%
Total			100%

[0076] The calculation of the pay table percentage is the same as was described above.

[0077] The pay table stores lists of paths and points, as in technique 3, described above. The list of paths may be substantially the same as Table 8 above. However, there is

associated with each point a list of paths that leads to it, rather than away from it, and the probability assigned to each path is the probability of that path being chosen as the path to use to get to the point, resulting in Table 17.

TABLE 17

Points		
Point number	Paths that end at this point	Probability of choosing the path
2	1	100%
3	2	100%
4	3	50%
	7	20%
	8	30%
5	4	100%
6	5	16%
	6	84%
... Table shortened for simplicity ...		

[0078] Referring to FIG. 14, there is shown a flow chart for a routine 140 for playing the game in accordance with this technique. When a ball launch is activated by the player, the routine at 141 randomly selects a route end point, based upon the probabilities in the pay table, and notes the implied final outcome. Then, at 142, out of the list of paths that lead to that end point, the routine randomly chooses one according to the probabilities assigned to the paths. Next, at 143, the routine traverses the path in reverse direction to its starting point, recording the path as part of the route to be used. Then, at 144, the routine checks to see if the path starting point has paths that lead to it. If it does, the routine returns to 142 and continues in this loop until it reaches a point that has no paths leading to it, which must be the route starting point. Then, at 145, the routine plays the game forwardly from start to finish using the recorded route and then, at 146, awards the player the amount dictated by the pay table for the final outcome that was chosen.

[0079] As was indicated above, a game such as pachinko may provide an added complication in that it is possible for two or more balls to collide. In such a case, a number of different possibilities exists for handling a collision.

[0080] (1) Award or bonus associated with the collision (the bonus could be preset or randomly drawn from a range of values). Then, swap the trajectories of the two balls that have collided such that each ball takes the other ball's trajectory and arrives at its outcome. This makes collisions easy to account for in pay table evaluation, since the final outcome is only affected by the addition of a collision bonus.

[0081] (2) Award, as a collision bonus, the amount that each ball individually would have been awarded, had it continued on its initial trajectory without colliding. At this point, the payout is the same as if the balls had not collided, but had passed through each other. Then, either let the balls continue randomly from that point, to yield an additional outcome and payout, or assign the balls new trajectories (which could be held in a bonus pay table) to yield new outcomes. In either case, the final outcome of the balls affects the collision's bonus. To calculate the effect to the pay table, compute the probability of a collision and the probabilities and payouts of the different outcomes after the collision.

[0082] (3) Award no bonus payout due to a collision. Rather, award a bonus ball, the outcome of which produces an additional payout. The possible outcomes of the bonus ball could be stored in a bonus pay table.

[0083] It will be appreciated that other variations of the above-described techniques would be possible, but the foregoing techniques are described in detail to illustrate the principles involved.

[0084] The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only and not as a limitation. While particular embodiments have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the broader aspects of applicants' contribution. The actual scope of the protection sought is intended to be defined in the following claims when viewed in their proper perspective based on the prior art.

What is claimed is:

1. A method of operating a video gaming machine which simulates a real physical game initiated by placing an object in motion in accordance with a set of initial conditions and proceeding to one of a plurality of outcomes corresponding respectively to final resting conditions of the object, the method comprising:

establishing in software a mathematical model of the game including a plurality of rules governing movement of the object once it is placed in motion,

establishing a range of possible values for each of a plurality of parameters,

randomly selecting for each parameter a value from its associated range of values to establish the set of initial conditions,

running the set of initial conditions through the model for simulating movement of the object to a final resting condition to determine the outcome, and

displaying the simulated movement of the object.

2. The method of claim 1, wherein the parameters include velocity, angle or direction and spin or rotation.

3. The method of claim 1, wherein the object is a ball.

4. The method of claim 1, and further comprising predetermining a pay table including a list of possible outcomes and a corresponding win amount for each outcome and, after determining the outcome, looking up the outcome in the pay table and awarding the player the corresponding win amount.

5. A method of operating a video gaming machine which simulates a real physical game initiated by placing an object in motion in accordance with a set of initial conditions and proceeding to one of a plurality of outcomes corresponding respectively to final resting conditions of the object, the method comprising:

establishing in software a mathematical model of the game including a plurality of rules governing movement of the object once it is placed in motion,

establishing a collection of sets of initial conditions large enough to simulate random play and assigning to each set a probability of occurrence,

randomly selecting a set of initial conditions from the collection in accordance with their probabilities of occurrence,

running the selected set of initial conditions through the model for simulating movement of the object to a final resting condition to determine the outcome, and

displaying the simulated movement of the object.

6. The method of claim 5, wherein the collection of sets of initial conditions is established by running the model a large number of times using a different set of initial conditions each time and recording each set of initial conditions and its outcome, and selecting from the recorded sets of initial conditions the collection of sets.

7. The method of claim 6, and further comprising assigning to each set of initial conditions in the collection an identifying number to make up a range of numbers, the random selection of a set of initial conditions from the collection being effected by randomly selecting a number in the range and looking up the corresponding set of initial conditions.

8. The method of claim 5, wherein the parameters include velocity, angle or direction and spin or rotation.

9. The method of claim 5, and further comprising predetermining a pay table including a list of possible outcomes and a corresponding win amount for each outcome and, after determining the outcome, looking up the outcome in the pay table and awarding the player the corresponding win amount.

10. The method of claim 5, wherein the object is one of plural objects, and further comprising performing the last three steps of the method of claim 5 for each object.

11. The method of claim 10, wherein the objects are balls.

12. The method of claim 10, and further comprising establishing a collision bonus for each collision of one object with another.

13. The method of claim 12, wherein the objects are balls, the collision bonus including awarding the player an additional ball.

14. The method of claim 12, and further comprising predetermining a pay table including a list of possible outcomes and a corresponding win amount for each outcome, after determining the outcome for each object, looking up each outcome in the pay table and awarding the player the corresponding win amount, the collision bonus including an additional win amount.

15. The method of claim 14, wherein the collision alters the paths of the objects and, therefore, their final outcomes, the collision bonus being the win amounts corresponding to the outcomes the colliding objects would have reached had the balls not collided.

16. The method of claim 14, wherein the collision does not affect the paths of the balls, the collision bonus being an arbitrary win amount.

17. A method of operating a video gaming machine which simulates a real physical game initiated by placing an object in motion in accordance with a set of initial conditions and proceeding along a route to one of a plurality of outcomes corresponding respectively to final resting conditions of the object, the method comprising:

determining a finite collection of points on a play field including a route starting point and at least one route end point corresponding to a final resting condition and a finite collection of possible paths of the object from

one point to another such that each point except route end points may have one or more paths leading away from it,

*math* assigning a probability of occurrence to each path and to each point,

randomly selecting a path from among the paths leading away from the route starting point in accordance with their probabilities of occurrence,

*math* causing the object to traverse the selected path to the point it leads to,

then randomly selecting a path from among the paths starting at the point at which the object is currently located in accordance with their probabilities of occurrence,

then repeating the preceding two steps until a route end point is reached, and

*ps disp* displaying the simulated movement of the object from route starting point to the route end point.

18. The method of claim 17, wherein each point other than the route starting point and a route end point corresponds to an object-redirecting obstruction.

19. The method of claim 18, wherein the play field and the obstructions thereon are stationary.

20. The method of claim 17, wherein the object is a ball.

*data parameter* 21. The method of claim 17, and further comprising predetermining a pay table including a list of possible outcomes and a corresponding win amount for each outcome and, after determining the outcome, looking up the outcome in the pay table and awarding the player the corresponding win amount.

*math* 22. A method of operating a video gaming machine which simulates a real physical game initiated by placing an object in motion in accordance with a set of initial conditions and proceeding to one of a plurality of outcomes corresponding respectively to final resting conditions of the object, the method comprising:

*math* establishing in software a mathematical model of the game including a plurality of rules governing movement of the object once it is placed in motion,

*data* establishing a pay table including a list of possible outcomes and the probability of occurrence for each outcome,

randomly selecting an outcome based on its probability of occurrence,

*math* running the selected outcome through the model in reverse to produce a set of initial conditions, then

*math* running the set of initial conditions through the model in proper order for simulating movement of the object to the selected outcome, and

*psa* displaying the simulated movement of the object.

23. The method of claim 22, and further comprising establishing for each outcome a set of final conditions.

24. The method of claim 23, wherein each set of final conditions is established by random selection from a collection of possible final conditions.

*A* 25. The method of claim 22, wherein the establishing of the pay table includes establishing a corresponding win amount for each outcome and further comprising looking up

the selected outcome in the pay table and awarding the player the corresponding win amount.

26. A method of operating a video gaming machine which simulates a real physical game initiated by placing an object in motion in accordance with a set of initial conditions and proceeding to one of a plurality of outcomes corresponding respectively to final resting conditions of the object, the method comprising:

determining a finite collection of points on a play field including a route starting point and at least one route end point corresponding to a final resting condition and a finite collection of possible paths of the object from one point to another such that each point except route end points may have one or more paths leading away from it, *d*

assigning a probability of occurrence to each path and to each point, *M*

randomly selecting a point from among the route end points in accordance with their probabilities of occurrence, *M*

randomly selecting a path from among the paths leading to the selected route end point in accordance with their probabilities of occurrence, *d*

causing the object to traverse the selected path in reverse to the point it leads away from, *M*

then randomly selecting a path from among the paths leading to the point at which the object is currently located in accordance with their probabilities of occurrence, *M*

then repeating the preceding two steps until the route starting point is reached, and *M*

then causing the object to retrace the selected paths from the route starting point of the selected route end point for simulating movement of the object along the route, and *M*

displaying the simulated movement of the object along the route from the route starting point to the selected route end point. *psa*

27. The method of claim 26, wherein each point other than the route starting point and a route end point corresponds to an object-redirecting obstruction. *d*

28. The method of claim 27, wherein the play field and the obstructions thereon are stationary. *d*

29. The method of claim 26, wherein the object is a ball. *d*

30. The method of claim 26, and further comprising establishing for each outcome a set of final conditions. *d*

31. The method of claim 30, wherein each set of final conditions is established by random selection from a collection of possible final conditions. *d*

32. The method of claim 26, and further comprising predetermining a pay table including a list of possible outcomes and a corresponding win amount for each outcome and, looking up the selected outcome in the pay table and awarding the player the corresponding win amount. *A*

33. A video gaming machine which simulates a real physical game initiated by placing an object in motion in accordance with a set of initial conditions and proceeding to one of a plurality of outcomes corresponding respectively to final resting conditions of the object, the gaming machine comprising:

a player input device for activating the game,  
 a display device,  
 a processor operating under control of a stored program and responsive to the input device for controlling the display device,

a memory device coupled to the processor and storing a mathematical model of the game including a plurality of rules governing movement of the object once it is placed in motion, and a pay table of win amounts respectively corresponding to different outcomes,

and a payout mechanism,

the processor program including a first routine responsive to a player input for randomly determining an origin state and running it through the model for simulating movement of the object to a final resting condition to determine an outcome and controlling the display device to display the simulated movement of the object, and

a second routine for determining from the pay table a wire amount corresponding to the outcome and actuating the payout mechanism to award that amount to the player.

34. The gaming machine of claim 33, wherein the origin state is defined by a set of initial conditions, and the first routine including a routine for randomly generating each initial condition of the set.

35. The gaming machine of claim 33, wherein the origin state is defined by a set of initial conditions, the memory device including means for storing a collection of sets of initial conditions, the processor program including a routine for randomly selecting a set of initial conditions from the collection.

36. The gaming machine of claim 33, wherein the memory device includes means for storing a plurality of points on a play field including a route starting point, one or more route end points and a plurality of intermediate points wherein each intermediate point has one or more paths leading to it and one or more paths leading away from it and the route starting point has one or more paths leading away from it and each route end point has one or more paths leading to it, the origin state being defined as the route starting point, the processor program including a routine for randomly selecting one of the paths leading from the route starting point and causing the object to traverse the selected path and then repeating the process until a route end point is reached.

37. The gaming machine of claim 33, wherein the memory device includes means for storing a collection of

sets of final conditions respectively corresponding to outcomes, the processor program includes a routine for randomly selecting an outcome and a set of final conditions corresponding to it and then running the selected set of final conditions backwards through the model to determine the origin state.

38. A method of developing a pay table for a video gaming machine which simulates a real physical game initiated by placing an object in motion in accordance with a set of initial conditions and proceeding to one of a plurality of outcomes corresponding respectively to final resting conditions of the object, the method comprising:

establishing in software a mathematical model of the game including a plurality of rules governing movement of the object once it is placed in motion,

creating a list of outcomes,

assigning a probability of occurrence to each outcome,

assigning a win amount to each outcome, and

determining a pay table percentage by multiplying each outcome's probability of occurrence by its win amount and summing the products for all of the outcomes in the list.

39. The method of claim 38, wherein the list of outcomes and their associated probabilities of occurrence are determined by selecting a plurality of sets of initial conditions and sequentially running the sets through the model to determine corresponding outcomes and to determine for each outcome a probability of occurrence.

40. The method of claim 39, wherein the sets of initial conditions are selected by randomly generating each condition of each set.

41. The method of claim 39, wherein the sets of initial conditions are selected by randomly selecting sets from a collection of sets of initial conditions.

42. The method of claim 38, wherein the list of outcomes is created by determining a finite collection of points on a play field including a route starting point and at least one route end point and a finite collection of possible paths of the object from one point to another, such that each point except a route end point has one or more paths leading away from it, and establishing for each point a probability of occurrence equal to the sum of the probabilities of all paths that lead to the point, setting an initial probability of occurrence for each path, and setting for each path a probability of occurrence equal to the path's probability multiplied by the probability of the point from which it leads.

\* \* \* \* \*